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THE RUDDY ECLIPSED MOON.

BY RICHARD A. PROCTOR.

I AM very sorry to find that Mr. Williams thinks I have handled his theory about the moon's being red-hot "rather roughly"; for the elucidation of truth, which as he truly remarks is the object we both have in view, is never aided by roughness of manner. Neither is it well, if one can avoid it, to adopt a tone of confidence—as of one who *knows* and feels competent to explain to those who do not know, or who have not as yet fully understood: yet unfortunately, I can adopt no other tone in this matter. The account given in my article on the "Ruddy Eclipsed Moon" was not meant as a defence of any particular "views," but as an explanation of certain facts; and beyond admitting that my explanation has been manifestly insufficient, since it has not made matters clear to Mr. Williams, one of my readers, I have no fault to find with it. I see, though, that the last sentence has been misunderstood by a correspondent, Mr. Harold Taylor (Answers, p. 401); and I think he is quite right in objecting to the wording of that sentence; for in it I say that under very favourable conditions, we get 500 times full moonlight from a totally eclipsed moon, where I meant to say that we get as much light from the moon as though *she* were illuminated by 500 times full moonlight. The totally eclipsed moon may, under favourable conditions, be 500 times as bright as a surface of weathered sandstone illuminated by full moonlight.

Mr. Williams's remarks may be divided into those which relate to physical considerations, where he is at home, and those relating to optical and mathematical considerations, where he is otherwise.

In regard to the first, I note that he limits his remarks to Prof. Langley's experiments with the bolometer. I myself attach so little weight to those experiments that in lecturing on the moon I constantly quote Prof. Langley's results in company with those obtained by Lord Rosse, and with the remark that I regard the latter as altogether the more trustworthy. I believe that the moon, however rapidly she may radiate the heat she receives, becomes exceedingly hot at the time of lunar midday. I am somewhat surprised, by the way, to find that Mr. Williams's red-hot moon theory depends on this sun-supplied heat; for, in the closing paragraph of his letter, he speaks of the "ruddy glow fading *during totality*." I had supposed the moon was ruddy, according to Mr. Williams's theory, with primeval heat. If she warms up to redness at lunar midday, and darkens measurably during total eclipse, then I cannot understand why, according to Mr. Williams's theory, there should be any difference between the amount of ruddiness in different lunar eclipses. The full moon ought always to be red hot. As a matter of fact, the moon has disappeared entirely in several lunar eclipses,—ancient as well as recent. She has also been often observed to glow with more light in the latter half of totality than in the former.

However, I am not concerned to show that I have understood more of Mr. Williams's theory than that it undertakes to explain the ruddiness of the eclipsed moon by inherent heat, primeval or sun-supplied, or both. The point which I *do* understand is the way in which that ruddiness is really caused by red light from the sun himself.

But here I find myself in a difficulty, because Mr. Williams's remarks on this point are such as to show that my explanation should have begun somewhat farther back. For example, when Mr. Williams says that if the sun were a bright point, behind the centre of the earth as looked at from the moon, he would not be visible at all (and perhaps still more when he regards *this* as deducible from Sir John Herschel's demonstration) he—how shall I put it without seeming to "handle" the matter "roughly?"—well, he shows that optical considerations have not received the same amount of attention from him as some others which he has dealt with in such a way as to instruct and interest great numbers of readers.

To begin with, Mr. Williams supposes that I have misunderstood Sir John Herschel's account of the matter. But as I had never read it, that is manifestly impossible. possess Herschel's "Outlines," and have read large portions of it; but, of course, I have not thought it necessary to read his explanation of a matter which I had already inquired into myself. I remarked on certain sentences quoted by Mr. Williams, as manifestly meaning something different from what he had supposed (manifestly that is to *me*, who had already considered the optical relations in question); but I had not read Herschel's explanation. I have, however, within the last ten minutes read Arts. 421, *et seq.* of the "Outlines of Astronomy." I need hardly say that I have found every part of Sir J. Herschel's explanation correct and excellent. The only exception I can take is that Herschel assumes on the part of his readers a fuller understanding of optical considerations than probably most of them possessed.

To those who understand optical principles it is hardly necessary to say that Herschel's account is not directed to the behaviour of *pencils* of rays emanating from different points of the sun, but only to the limiting directions of single rays which have passed through our earth's atmosphere. There is not any remark about *foci*, nor indeed can any one discuss the *focal* convergence of rays through such an atmosphere as our earth's, or any shell of that atmosphere. All that could be done in that way would be to consider the character of any small pencil of rays from any point on the sun, after that particular pencil had passed along its own track through our atmosphere; and I need hardly tell the optical student that any such pencil of rays, divergent necessarily at entering our atmosphere, would be divergent after passage through it. The *axes* of all the pencils, infinite in number, proceeding from different points on the sun towards the earth's

atmosphere (or rather towards that ring of atmosphere operative in refracting the rays towards the moon) would of course be convergent after passing through the atmosphere. This distinction between the rays forming a pencil of light, and the axes of different light-pencils, is commonly a stumbling-block with optical students; and I think Herschel would have done well to remember this, and to explain (however obvious the matter may be to the more advanced) that he is not dealing with pencils of light, nor therefore considering foci, in Arts. 421, *et seq.*

The axes of light-pencils proceeding from any point on the sun's face, would be deflected by the varying refractive effects of the successive strata of the earth's atmosphere (from the outskirts producing scarcely any deflection to the lowest layers, the rays actually grazing the earth's surface being most deflected) into a region such as Herschel has indicated in his treatment of the subject, before he limits his remarks to grazing deflection only. An eye situated anywhere within this region would receive that particular pencil which came in the right direction to fall on the eye-pupil, instead of the pencil which the eye would have received if the earth with its atmosphere were not in the way; and this eye, instead of seeing that point in its true direction would see it as a point (or as nearly point-like as a refracted pencil can make a point of light appear) apparently close to the earth's globe. This starlike point would lie somewhere within two miles from the earth's surface, which at the moon's distance would look like actual contact. Or it might be, according to the position of the point, that two pencils would be received by it, from opposite sides of the earth. And, if we can imagine such a thing as an actual point of light being exactly beyond the earth's centre, then the eye would receive pencils from all round the earth, and that point of light would be transformed into an exceedingly delicate ring. As the point passed the earth's centre, its appearance would be changed from two starlike images into this fine ring, and then instantaneously into two starlike images again.

With regard to the amount of light received from the sun during a total lunar eclipse, Herschel and Mr. Mattieu Williams are indeed at one in saying that all this light comes from a ring of air, looking (as seen from the moon) very small compared with the disc of the earth. And Mr. Williams is quite right in his estimate of the apparent size of that ring. In fact, he could not well have been otherwise. Where he goes wrong is in supposing that that ring would look no brighter than the sun-lit earth or atmosphere, whereas it would really look as bright as the sun's disc seen through just so much air as happened to be along the track of the light-pencils received by our imaginary eye at the moon's surface. Herschel very rightly says that the illumination of the region from which the ring-shaped image of the sun could be seen would be very feeble. I have calculated what that illumination would be if the absorption of light by the particular regions of air operative in deflecting the sun's rays were about one-half, and I find that the amount of light would be only $\frac{1}{1775}$th of full sunlight. This would be the maximum, and even this we could hardly admit if we did not remember that the rays actually received on the moon's surface during mid-totality are not for the most part refracted through the lowest parts of our air, but through regions a mile or two above the earth's surface, where the absorption is very much less than what we recognise in the case of the setting sun.

But Mr. Williams, anxious to show that I differ from Herschel, who had also said that the light would be feeble compared with sunlight, considers that I have no right, by my own showing, to agree with Herschel. "Mr. Proctor surely understands that if the *whole sun* is represented by that ring, in the manner he describes, the intensity of the luminosity of the ring, as compared with that of the solar disc, will vary inversely with the apparent area of the ring as compared with the apparent area of the disc; or, otherwise stated, the total luminosity of the ring will be equal to the total luminosity of the disc (viewed under like circumstances) whatever be their comparative areas." But this is what I not only do not "surely understand," but deny and reject utterly. I have shown (KNOWLEDGE, Vol. IV., pp. 133-34) that no optical contrivance whatever can make an object look brighter than it really is; apart from absorption which diminishes light, we get exactly the same brightness, neither more nor less, whether an object be magnified or parvified (if I may be allowed to coin a word), so only that it be not magnified so much that the pencils of light from individual points do not fill the whole eye-pupil.* Short of this degree of magnification, we get more light from an object, the larger it is made to look, by any contrivance of lenses or reflectors, but its apparent intrinsic lustre is not changed, except by absorption of light; and the smaller an object is made to look by parvification, the less light we get from it. Now, the earth's atmosphere does not act differently in this respect from optical contrivances made by man. It reduces the sun's image in size, besides very curiously affecting his apparent shape; but it cannot alter his apparent lustre, except by reducing it through absorption. Thus the light from that ring-shaped image of the sun is less than the light from the sun itself, in the same degree that that image is less than the solar disc, and also in proportion as the sun's light is absorbed.

Mr. Williams may probably say that I have here simply repeated what he holds to be an incorrect statement. But I cannot do much more. The general proof of the law that under no circumstance can the apparent brightness of a luminous surface be increased cannot be understood without more special study of the laws of brightness than Mr. Williams has yet cared to make. I have given the proof in the *Monthly Notices of the Astronomical Society*, and no one acquainted with the laws of optics will for a moment dispute the matter. In point of fact, any optical contrivance or natural arrangement of refracting media or reflecting surfaces by which a body is made to look smaller, produces effects equivalent to those resulting from increase of distance, and we no more get full sunlight from a diminished image of the sun than we get full sunlight from some star which, though as large as our sun, is reduced to a much smaller apparent size by its much greater distance. In whatever degree the sun's apparent size, as supposed to be seen from the moon, is reduced by the interposition of the earth, in that degree *at least* is the amount of light falling on any part of the moon reduced. If Mr. Williams will look at the sun through an opera-glass turned small end from him, or at the small image of the sun seen in a convex reflecting surface of small radius, he will have at any rate two good examples of the general law I have indicated.

I might, in conclusion, notice—but I am not sure the force of the illustration will be felt—that the same considerations which lead to the mistake that a starlike point beyond the earth's centre would not be visible from the moon's surface, would show also that a star would not in general be visible when near the horizon. For if we take any particular layer, say the lowest, of our air, it is certain

* For instance, when we use a high power on a planet or on the moon, the beams of light sent by the object-glass to a focus (the image of a point on the observed body) are intercepted by the eye-piece before they have opened out to the breadth of the eye-pupil; the higher the power, the narrower are these emergent beams, and the fainter is the illumination of the object.

that the rays from the star will be carried by the deflecting power of *that layer*, along some particular direction, and unless the eye be exactly on their course, those rays would not make the star visible. But the eye selects the particular pencil of rays coming to it, and sees the star in the corresponding direction.

In conclusion, let me again point out that I am not advocating any theory, speculation, or conclusion of my own, but simply endeavouring to remove an objection which has been raised (through misapprehension) against the true explanation of the ruddy-eclipsed moon,—an explanation accepted by all who are sufficiently acquainted with optical principles to examine it understandingly. Of Mr. Williams's speculation about the moon being red hot, I simply say that while it *appears* to be disposed of by the entire blackness of the moon during some total eclipses, it *certainly* cannot be supported by such reasoning as he has based on misapprehension of the accepted interpretation of the ruddy-eclipsed moon. But I do not feel in the slightest degree anxious to galvanise it into apparent life by attacking it.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

WE now turn to another family of beetles, the *Dermestidæ*, a group of small extent, but of most destructive habits. One of them (Fig. I.) has rendered itself sufficiently obnoxious to have acquired a popular name, the "Bacon beetle," a designation which indicates not a necessary association, but merely a casual one, which, however, has, more than any other, brought the insect under the notice and reprobation of human kind. In scientific language it is still called by the name under which the great Linné wrote of it in his "Systema Naturæ," viz., *Dermestes lardarius*, the second word of which is an almost literal translation of the popular name. The generic title *Dermestes* is from the Greek *derma*, a skin, and indicates that the tastes of the insect lie not only in the direction of fat bacon, but equally in that of tough leather.

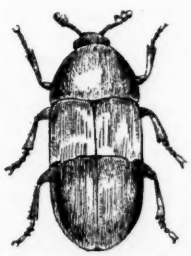


Fig. 1.—Dermestes lardarius.

It is a parallel-sided convex, rather elongate insect, about ¼ in. long, and may be at once recognised by the yellowish-grey band which sweeps right across the elytra, occupying almost the whole of their basal half (*i.e.* the part next the thorax), in sharp contrast to the black of the remainder of the body both before and behind; the two colours meet abruptly in a well-defined, somewhat wavy boundary line, running across from side to side. In the present order it very frequently happens that, as we have already seen in *Niptus*, the colours that appear on the surface are not ingrained into the skin of the insect itself, but are produced by hairs or scales with which it is more or less thickly coated, and it is not until these have been removed that the true colours of the body, which do not necessarily correspond with the superficial ornamentation, can be clearly ascertained. The present insect is covered tolerably thickly with hairs, and the parts that are superficially black are also of that colour when denuded of their covering, but under the pale patch the elytra are of a very deep reddish brown.

The head is of small dimensions, and, when the insect is at rest, is carried bent down beneath the thorax, a position from which, in a defunct individual, the coleopterist who desires all parts of his specimens to be properly displayed, finds it no easy matter to coax it out. The antennæ are of the type known as clubbed, a feature which indicates that the insect belongs to that large section of the beetle order called Clavicornia, or Club-horns, a group containing about 600 British species, a good many of which are feeders upon carrion and the dried carcasses of other animals. A clubbed antenna is usually almost abnormally short, and may be at once distinguished by the fact that the terminal joints, two, three, four, or five in number, are much broader than the rest. It is surprising how many varieties this very simple peculiarity is capable of, and these variations are of much importance in the systematic arrangement of the insects. In our present species, the club consists of three flattened joints, broadened inwardly only, whereby it acquires a one-sided appearance.

The legs are of moderate length, and are packed up under the body when their owner counterfeits death, as it very readily does on the slightest alarm, being, as well becomes so inveterate a pilferer, of timid and retiring habits. But this folding-up is not so perfectly carried out as in many other insects, for the last section of the limbs—viz, the five-jointed tarsus, or foot, is not folded back upon the preceding part, or tibia, but simply brought up so as to make an angle with them.

The larva of *Dermestes* is something like a very hairy caterpillar, and is no connection of those lively maggots that also infest bacon, and whose acrobatic feats have earned for them the name of "jumpers;" it casts its skin several times in the course of its life, and on account of the multitude of hairs (which are shed with the skin and renewed each time), the rejected vestment does not shrivel up, but retains the form of the larva, a very substantial ghost of its former self.

We possess five British species of this genus, all of which are essentially devourers of skins and dried carcasses; in fact, they are the jackals of the flesh flies, coming round when the maggots of the latter have finished up all the soft and juicy parts of a fresh carcass, and clearing off the hard and dry remnants of the skin, tendons, ligaments, &c, which their predecessors have left untouched. This is their natural function in the economy of nature, and when man also accumulates stores of dried meats, skins, feathers, horns, and hoofs, it is not to be wondered at that they forsake the scanty and precarious provisions of dame Nature, and invade his precincts who has so thoughtfully laid up such grand stores for them.

Some years ago, *D. vulpinus*, a black species with a white patch on each side of the thorax, swarmed to such a degree and was so destructive in large skin warehouses in London as to bring forth the handsome offer of a reward of £20,000 for an available remedy. But satisfactory remedies against the ravages of insects are usually difficult to discover, and difficult also to apply, and it is not altogether surprising that even so tempting an offer failed to secure the desired result. The curators of museums, too,

are likely to have their peace of mind affected by the ravages of *Dermestes*. The larvæ are by no means particular as to the class to which a preserved animal belongs, and so birds, beasts, and fishes, crabs, insects, and spiders, may any or all fall before their jaws. Sometimes they will attack a skin by nibbling away at the roots of the hair or feathers, and so making a nice clean shave of the whole affair. Occasionally they will forsake an animal for a vegetable diet; cork is a substance much favoured with their attentions, and an account has been placed on record of the destruction of a whole ship's cargo of this material by vast numbers of them. On another occasion they actually abandoned some tempting skins on which they had been feasting for a set of corks that had been introduced into their quarters. Nor is the housewife exempt from anxiety on the score of *Dermestes*. Not only flitches of bacon, but even the meat in larders and the bladders covering the tops of jam-pots have on occasions yielded to their rapacity; books and paper, too, are not safe, and, strangest of all, they have sometimes actually imitated the example of *Anobium*, and bored into wood, feeding on the timber as they advanced.

But the most repulsive charge against them is that of anthropophagy. Some years ago, some Egyptian mummies were discovered which, perhaps through straitened circumstances in the family to which they belonged, or through the shiftiness of some dishonest firm of embalmers, had evidently been prepared with less care than was usually expended on such objects. On being unswathed, the bodies were found to be pierced in some places by an insect identical with the London warehouse pest above referred to, viz., *D. vulpinus*, some examples of which had worked their way through two or three folds of the mummy-cloth and there perished. The bodies, on being opened, were found to contain thousands of the larvæ, together with many more of the perfect beetles—of course, all mummified and saved from decay by the same drugs as had preserved the mummy itself. From the facts that death had overtaken the larvæ in the fulness of their powers, that only a few beetles had escaped from the body, and that these had not been able to work their way out completely, it is manifest that they must have commenced their attacks during the preliminary processes of embalmment, when evidently the body had been somewhat neglected, and that most of them had been killed by the later stages of the operation, a few only surviving its completion, and they were without strength sufficient to eat their way completely through the investing mass into daylight. The *Dermestes* were accompanied by another beetle, a bright blue species called *Corynetes violaceus*, which also is a common British insect and a devourer of carrion and skins, though belonging to a different family. It was well for the feelings of the survivors and owners of the precious relics that all these insects perished where and when they did; for think what a shock it would have given to the family to see a host of beetles come trooping out of the corpse of their respected relative, the integrity of whose remains had been an object of their pious care! In consequence of the great amount of preservatives used, the bodies themselves, when once properly prepared, would probably be exempt from insect attack, but not so the wooden cases in which they reposed, which could easily be, and were, perforated by wood-borers such as *Anobium*, and, to judge from some in the British Museum, the ancient Egyptian may have had to look as sharply after the coffins of his grandfathers as the modern Englishman after his chairs and tables to prevent them from becoming worm-eaten.

(To be continued.)

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

X.

IT is desirable to deal rather fully with the gesture-language used by deaf-mutes, as the inquiry throws a very strong light on the mode in which language in general may have been developed; but before proceeding to examine this development in detail, it will be interesting to inquire into the origin of those apparently natural signs which are used alike by civilised and savage peoples, by speakers and by the speechless, to express assent or dissent, signs which are of the greatest importance.

Assent is expressed by Europeans by a nod of the head, whereas for dissent the head is shaken from side to side. These gestures are some of those that have become so engrained in the human mind that they are performed by those who, owing to brain-disease, have lost all power of using verbal language; and another class of patients who are able to pronounce words, but use them in such a way that they express no ideas, shake their heads to show that they are using a word wrongly, and will nod the head to signify assent even when they are uttering the word "No!" That these signs are instinctive, at any rate in some nations, is further rendered probable by the fact that Laura Bridgeman, to whom I have previously referred as being both blind and deaf, "constantly accompanied her *yes* with the common affirmative nod, and her *no* with our negative shake of the head," as Lieber, her teacher, asserts.

Vogt also speaks of a microcephalous idiot, who, in answer to questions as to whether he wished for more food or drink, used to incline or shake his head.* Schmalz assumed that in the case of children only a degree above idiotcy these signs can be made and understood.

Signs used to express assent and dissent may be regarded as primarily expressive of feeling. With a smile of approbation a vertical nod is often given, while with a frown of disapproval the head is frequently shaken from side to side. All gestures expressive of assent and dissent probably had their origin in movements of approach to, or acceptance of, something pleasant, and of avoidance or refusal of things unpleasant. Nor does this involuntary origin detract from their present value as voluntary signs expressive of thought. For, as Darwin says, he does not believe "that any inherited movement which now serves as a means of expression, was at first voluntarily and consciously performed for the special purpose. . . . On the contrary," he observes, "every true or inherited movement of expression seems to have had some natural and independent origin. But, when once acquired, such movements may be voluntarily and consciously employed as a means of communication."†

A man rejecting a proposition will shut his eyes and avert his head, as if he wished to avoid an unpleasant sight; and when this approval or dissent is expressed the mouth is frequently pursed up, while the head is shaken as if in avoidance of a nauseous morsel which some one is endeavouring to force upon him. I have seen the same actions in little children refusing to take a dose of medicine.

Thus natural expressions may become voluntary signs. Savages, when pleased, not only smile, but make gestures indicative of joys connected with eating. Petherick says that the negroes on the Upper Nile began a general rubbing of their bellies when he showed them beads. Leichhardt remarks that the Australians smacked their lips and

* "Mémoire sur les Microcéphales, 1867," p. 27.
† "Expressions of Emotions," Ed. 1872, p. 356.

clacked their tongues when they saw his horses, bullocks, and especially his kangaroo-dogs. The Greenlanders, according to Cranz, "when they affirm anything with pleasure suck down air with a certain sound." Probably an imitation of the manner in which a favourite morsel is sucked down.

With infants, the first act of denial consists in refusing food, and Darwin* repeatedly noticed with his own infants that they did so "by withdrawing their heads laterally from the breast, or from anything offered them in a spoon. In accepting food and taking it into their mouths they inclined their heads forward. . . . . It deserves notice that in accepting or taking food there is only a single movement forward, and a single nod implies an affirmation. On the other hand, in refusing food, especially if it be pressed on them, children frequently move their heads several times from side to side, as we do in shaking our heads in negation." Moreover, in case of refusal, the head is not rarely thrown backwards, or the mouth is closed, so that these movements might likewise come to serve as signs of negation. Mr. Wedgewood remarks† on this subject, that "when the voice is exerted with closed teeth or lips, it produces the sound of the letter *n* or *m*. Hence we may account for the use of the particle *ne*, to signify negation, and possibly also the Greek *mê* in the same sense;" but as to this there will be more to say hereafter.

The gestures of nodding and shaking the head are, Darwin observes, not so universally employed as he would have expected. They are nevertheless very general, and are used by the Malays, the natives of Ceylon, the Chinese, the negroes of the Guinea coast, "and, according to Geike, by the Kaffirs of South Africa, although with these latter people Mrs. Barber has never seen a lateral shake used as a negative. With respect to the Australians, seven observers agree that a nod is given in affirmation; five agree about a lateral shake in negation, accompanied or not by some word; but Mr. Dyson Lacy has never seen the latter sign in Queensland, and Mr. Bulmer says that in Gipp's Land a negative is expressed by throwing the head a little backwards and putting out the tongue." Near Torres Straits, according to Mr. Jukes, the natives, when uttering a negative do not "shake the head with it; but holding up the right hand, shake it by turning it half round and back again two or three times." Modern Greeks and Turks are said to throw back the head with a cluck of the tongue for negative, and the Turks to express *yes* by a movement like our shaking the head. The Abyssinians express a negative by jerking the head to the right shoulder with a slight cluck, the mouth being closed. The Dyaks of Borneo are said to express affirmation by raising the eyebrows, and negation by slightly contracting them with a peculiar look from the eyes. Professor and Mrs. Asa Gray consider that nodding in affirmation is rare, while shaking the head in negation is neither used nor understood by the Arabs on the Nile. With the Esquimaux a nod means *yes* and a wink *no*. The New Zealanders elevate the head and chin as a sign of acquiescence, which may be a relic of the habit of craning the neck to see a distant object better.

The signs of affirmation and negation in use among the Hindoos seemingly vary, a nod and lateral shake being said to be used sometimes as by us, but a negative to be more commonly expressed by the head being suddenly thrown backwards a little to one side, with a cluck of the tongue. A native gentleman has stated that affirmation is frequently shown by the head being thrown to the left. Mr. Scott, after repeated observations, believes that a vertical nod is not commonly used by the Hindoos in affirmation, but that the head is first thrown backwards either to the left or right, and then jerked obliquely forwards only once. In negation, he says, the head is usually held nearly upright, and shaken several times.

The Fuegians nod vertically in affirmation and shake the head laterally in denial, and the wild Indians of North America do the same; but Mr. W. Mathews asserts that these actions are not natural to the latter tribes, having been learnt from Europeans. He says that they express affirmation by describing with the hand (all the fingers except the index being flexed) a curve downwards and outwards from the body, whilst negation is expressed by moving the open hand outwards with the palm facing inwards. Other observers state that in affirmation these Indians raise the forefinger and then lower and point it to the ground, or wave the hand straight forward from the face, while the sign of negation is the finger or whole hand shaken from side to side.* The Italians are also said to shake the lifted forefinger from right to left in negation, and the same gesture is sometimes used by English people.

The shaking of the hand or finger may, as Darwin suggests, be symbolic of the lateral movement of the head; or possibly, as it seems to me, it may have originated in the shaking of various parts of the body to get rid of a local irritation. The sudden backward movement of the head is often performed by infants and others in refusing food. The former, which is the sign of negation among the Dyaks, often accompanies shaking of the head among people who make the latter gesture.

Regarding affirmation, Darwin remarks: "The eyebrows are sometimes raised in affirmation, and as a person in bending his head forwards and downwards naturally looks up to the person whom he addresses, he will be apt to raise his eyebrows, and this sign may have arisen as an abbreviation. So again with the New Zealanders, the lifting up the chin and head in affirmation may, perhaps, represent in an abbreviated form, the upward movement of the head after it has been nodded forwards and downwards."

On the whole, the suggestion that gestures expressive of assent and dissent have arisen from natural movements performed in order to obtain pleasure or avoid pain, is, I think, fully justified by the varied evidence quoted above, and they afford a most perfect example of the manner in which involuntary gestures expressive of feeling may develop into gestures voluntarily performed for the purpose of conveying thought, and even become so apparently conventional that their origin can only be discovered after a considerable amount of inquiry. The fact that instinctive gestures may thus become, to all intents and purposes, conventional signs, is one that has a bearing of the greatest possible import on the theory of the evolution of language, and I shall show hereafter that it forms, as it were, a bridge between the language of the lower animals and that of man.

* See "Expression of the Emotions," pp. 273-7.
† "On the Origin of Language," 1866, p. 91.

* James asserts that North American traders express *no* and *not* by waving the hand outwards with the thumb pointed upwards; but Dunbar maintains that the negative is indicated by holding the hand palm outward and vibrating it to and fro.

ARAGO ON SHOOTING STARS.

IN connection with what has recently appeared in these columns on shooting stars, the following passage, translated from the French "Annuaire" for 1836, will be read with interest. The popular portion of the work for several years was written by M. Arago.

"These phenomena, which have often been considered

unworthy of investigation, and regarded simply as atmospheric meteors originating in the inflammation of a quantity of hydrogen gas, have, in consequence of recent observations, become objects of greater attention among men of science. Previous theories limited their place in the heavens to our own atmosphere; but from observations made at Breslau and other places by Professor Brandes and several of his pupils, the height of some shooting stars has been calculated at 500 English miles; and the rate at which they move not less than thirty-six miles in a second, which is nearly double the rate of the earth's motion round the sun. If a reduction be made to one-half of this rate per second, in order to allow for the illusion occasioned by the motion of the earth, the real motion would be eighteen miles per second, which, with the exception of the earth, would still be more rapid than that of any of the principal bodies of our system. In the attempts which have been made to ascertain the apparent direction in which shooting stars usually move, it has been ascertained that, although they become ignited in our atmosphere, they come from beyond it. It is singular that their general direction should be contrary to that in which the earth moves in its annual orbit; and it is much to be desired that the inferences already deduced should be corrected or confirmed by a greater number of observations. We think that the officers of the watch on board the *Bonite*,* should be invited, during their voyage of discovery, to note the hour of the appearance of each shooting star, its angular height above the horizon, and especially the direction in which it moves. In referring these meteors to the principal stars of the constellations which they traverse, the different questions here raised can be easily settled.

"The means of accounting for the extraordinary appearance of luminous projectiles observed in America in the night of November 12 and 13, 1883, are not very satisfactory, unless it be assumed that, besides the planetary bodies which revolve round the sun, there are myriads of smaller bodies which only become visible at the moment when they come within our atmosphere and assume a meteoric appearance; and that these asteroids (to use the term which Herschel formerly applied to Ceres, Pallas, Juno, and Vesta) move in groups; and that they move singly also. A careful observation of shooting stars is the only means of enlightening us on this curious subject.

"The shooting stars in America, to which allusion has been made, were observed in 1833. They succeeded each other at such short intervals that it was impossible to count them; and the most moderate calculations fixed their number at hundreds of thousands. They were so numerous, and showed themselves in so many quarters of the heavens at the same time, that the attempts to estimate them were only rough guesses. At the Observatory at Boston their number was considered to equal one-half of the flakes which fill the air in an ordinary fall of snow. When their numbers were diminishing, 650 stars were counted in fifteen minutes, in a circumscribed part of the heavens, which did not comprise a tenth part of the visible horizon; and these did not amount to more than two-thirds of the whole number seen, which was at least 866; and if the whole hemisphere could have been surveyed by one observer, the number seen would have been 8,660, or 36,640 per hour. As the phenomena continued more than seven hours, the number of shooting stars visible at Boston was upwards of 240,000; and it should be recollected that the basis of this calculation was taken when the intensity of the phenomenon was diminishing. It was visible along the whole of the eastern coast of North America, from the Gulf of Mexico to Halifax, from nine o'clock in the evening to sunrise, and in some places in full daylight, at eight o'clock in the morning. All these meteors came from the same point of the heavens, viz. γ of Leo, and those which were seen elsewhere was the effect of the earth's movement which caused an apparent alteration in the position of this star. The above facts are certainly very curious, but the following are not less so.

"The shooting stars observed in the United States appeared in the night of the 12th and 13th of November. In 1799 a similar phenomenon was observed in America by M. de Humboldt, in Greenland by the Moravian Brethren, and in Germany by various individuals; and the period of its appearance was also the night of the 12th and 13th of November. In 1832, in Europe and some parts of Asia the phenomenon was witnessed; and the date was still the night of the 12th and 13th of November. This identity of dates induces us to urge upon our young seamen the task of observing with attention the appearances in the firmament between the 10th and 15th of November. Since my report has been read to the Academy, M. Berard, one of the most intelligent officers of the French marine, has favoured me with the subjoined extract from the journal of the brig *Loiret*, which he commands:—

"'The 13th of November, 1831, at four o'clock in the morning, the sky being perfectly cloudless, and a copious dew falling, we have seen a number of shooting stars and luminous meteors of great dimensions. During upwards of three hours more than two per minute were seen. One of these meteors, which appeared in the zenith, left an immense train from east to west like a luminous band, and in it many of the colours of the rainbow were distinctly visible; its breadth was equal to one-half of the moon's diameter, and the light which it gave did not disappear for six minutes. We were on the coast of Spain, near Carthagena.'

"On Nov. 13, 1835, a large and brilliant meteor fell near Belley, in the department of the Ain, and set fire to a farmyard. In the same night of Nov. 13 a shooting-star, larger and more brilliant than Jupiter was observed at Lille by M. Delezenne. It left on its passage a shower of sparks precisely similar to those which follow a sky-rocket.

"The facts we have now given confirm more and more the existence of a zone composed of myriads of small bodies, whose orbits come within the limits of the earth's ecliptic every year between the 11th and 13th of November. This is a new planetary world which begins to open to us. It is almost unnecessary to state how highly important it is to ascertain if other masses of asteroides do not come within the earth's ecliptic at other points than that which it reaches about Nov. 12. It is desirable to make observations between April 20 and 24, as well as in November; for in 1803, on April 22, I believe, from one o'clock in the morning until three, shooting stars were seen in all directions in such great numbers, in Virginia and Massachusetts, as to be compared to a shower of sky-rockets. Messier states that on June 17, 1777, towards noon, he saw in the space of five minutes a very large number of black globules pass over the sun's disc. Were not these globules also asteroides?"

* A French vessel on a voyage of discovery.

GAS AT NEW YORK.—The most prosperous gas company in New York last year was the Mutual, which realised an average net profit of 1·09 dols. per 1,000 cubic feet. It received 2·29 dols. per 1,000 cubic feet. The least successful was the Harlem, which realised a profit of 45 cents; the Manhattan, reporting 82 cents; the Municipal, 1·02 dols.; the Knickerbocker, 96 cents; the Metropolitan, 85 cents; and the New York, 72 cents.

ANIMALS OF THE PRESENT AND THE PAST.

BY RICHARD A. PROCTOR.

MR. GRANT ALLEN (for to his facile pen the article on "Big Animals," in a recent number of the *Cornhill Magazine* may safely be attributed), has done good service in showing how unfounded are two very prevalent ideas respecting the past of this earth on which we live—viz., first, the idea that the various races of animals which appear in the geologic record all existed at some remote time ("in those days," meaning some imaginary epoch specially belonging to geological science); and secondly, the idea that in past ages the animals existing on the earth were very much larger than those now known.

As regards the first idea, relating to geological time, the Pleistocene age is really as yesterday in the past history of our earth, and the Pliocene as the day before yesterday. The mammoth in the northern hemisphere, and the moa in the southern, are creatures of yesterday, while the mastodon, on the same time scale, can be set no further back than the last generation or so. On the other hand, the "monstrous" marine saurians of the Jurassic era are of remote antiquity. Mr. Allen expresses the relation, in point of time, neatly, when he says that "to compare the relative lapses of time with human chronology, the mastodon stands to our own fauna as Beau Brummel stands to the modern masher, while the saurians stand to it as the Egyptians and Assyrian warriors stand to Lord Wolseley and the followers of the Mahdi." In fact, the mind, as regards its power of dealing with time-intervals, is lost in the presence of the vastness of the era to which our own period belongs as compared with the minute span over which history extends its survey—is lost, yet once more, in comparing even with the vastness of the glacial period the seemingly immeasurable duration of the Pliocene and its still longer predecessor the Miocene, and, endeavouring to look beyond these into still remoter depths of past time, is simply appalled. The Eocene was so long-lasting, that the sequent eras, which with it make up the Tertiary period, seem by comparison as seconds compared with hours. But the whole duration of the Tertiary period is insignificant compared with the inconceivable length of the Secondary period, while the Secondary period, in turn, is short compared with the Primary period, and even this tells us only of the close of a yet more tremendous time-interval, during which no trace was left of the earth's progress to the world form, any more than the sea leaves any record of the progress of the storms which sweep over its vast surface.

Truly it is amazing to consider now, when these vast periods of time have taken their place among the recognised and assured teachings of the great earth-volume, that but half a century or so ago a struggle was still maintained to reduce our estimate of the earth's past existence to a few thousands of years, while multitudes of well-meaning persons imagined that an eternity of future happiness or misery depended on each man's rejection or acceptance of the doctrine which God's work, the earth, assuredly teaches. Yet, strangely enough, the school of those who maintained that hopeless struggle is not ashamed even now to denounce the followers of the scientific school for accepting the obvious meaning of these new pages of that great volume which have since been turned over.

With regard to the dimensions of the modern inhabitants of the earth, we must remember that to every era of the earth's history a special kind of development has been specially appropriate. It is certain that the great land monsters of the Jurassic age could not exist now. For while their numbers must have always been limited, even when surrounding conditions favoured their existence, the powers of the human race at the present time would be fatal to the existence of these unwieldy monsters. The monstrous eft, which of old was lord and master of earth, might maintain, at least for awhile, the position of lord and monarch still, were it not for man. But with man in the arena against the Atlantosaurus, one or other would have to give way, and it would not be man. The mammals of the Pliocene age were not so much greater than their modern representatives that we need consider them specially. And assuredly when we turn to the sea-monsters of our own time we need not fear comparison with even the mightiest monsters of past geological ages. The Rorqual attains sometimes to a length of fully one hundred feet, the razor-back whale sometimes measures seventy feet, and there are other cetaceans not much inferior in size. As to the dimensions of sharks, some doubt appears to exist. Considering the nature of the creature, and that men have never found it desirable to hunt for sharks as they have for whales (possibly if they had they would have made but unsatisfactory progress in the art of shark-hunting), it would be absurd to suppose that we have become acquainted even with the largest existing varieties, far less with the largest individual specimens. To give an idea of the state of things in regard to sharks, I may record an experience of my own. In the voyage from Auckland, N.Z., to Honolulu, the *City of Sydney* was temporarily disabled by the breaking of a crank-pin. Up to the day when this accident occurred, not one among the crew or passengers had seen a single shark of any kind, though the passengers certainly passed a good half of their time looking at the waters around them. But scarcely had we been at rest a quarter of an hour before the sea all around our disabled ship was literally swarming with sharks. When I learn, therefore, that the naturalists of the *Challenger* expedition have dredged up in numbers from the ooze of the Pacific shark teeth five inches long by four wide, which would indicate that the sharks to which these teeth belonged were a hundred feet long, I feel no doubt that sharks of these dimensions are still in existence. Dr. Günter, of the British Museum, writes, it is true, that "as we have no record of living individuals of that bulk, the gigantic species to which the teeth belonged must probably have become extinct within a comparatively recent period." And Mr. Grant Allen speaks of him as a very cautious naturalist for thus avoiding the natural conclusion that the species is not extinct at all. But to my mind it savours of much greater daring to imagine the extinction than the existence of these gigantic carcharodons. We know of nothing which could probaby have led to the extinction of monsters such as these, which would have all their own way among the denizens of the great deep. Man has not sought their destruction as he has sought the destruction of species of whales which nevertheless still exist; they cannot have been attacked and destroyed by other species of fish, or even conceivably deprived of the means of living by more active and predaceous creatures. That they should die out, then, seems altogether unlikely; whereas it is altogether natural that they should remain unknown amid the depths of the mighty ocean, for they would keep to the great deep, avoiding even an approach to shallows, nor would they be apt to show where the smaller and more numerous orders of sharks are seen.

Albeit I may remark that Mr. Allen seems to me mistaken in assuming that the monstrous sharks to whom these teeth belonged were as large as any sea creatures of

remote geological eras. I have in my possession shark's teeth collected in the nighbourhood of Charleston, S.C., which are 5½ in. long by 4½ in. broad, and in the Museum of Charleston they have shark's teeth much larger even that that.

The largest calamaries of the present time are certainly larger than any of those whose remains exist as fossils. A cuttle thrown up on the shore of Newfoundland was 80 ft. long.

On the whole, it may be doubted whether at any time in the past history of the earth the average size of the ten largest creatures by sea and land exceeded the average size of the ten largest species existing at the present day.—*Newcastle Weekly Chronicle.*

THE ORIGIN AND HOME OF THE DIAMOND.

By W. JEROME HARRISON, F.G.S.

THE DIAMOND IN SOUTH AFRICA.

(*Continued from page* 439.)

THE difficulty of transport has been a great drawback to the success of the diamond-mines grouped round Kimberley, the nearest railway—from Port Elizabeth to Bloemfontein—being 200 miles distant, and all traffic being conducted over the heavy sandy soil by bullock-wagons and (for passengers) a ten-horse coach. For this reason the price of coal at the diamond-mines has averaged £15 per ton. But in November last a new line connecting Cape Town with the Orange River was completed, from which Kimberley is distant only 74 miles. Another point of interest is that the new gold-fields of the Transvaal lie about 500 miles north-east of Kimberley, on the slopes of the Drakensberg Mountains, where the Vaal rises, and from which the diamonds found in the river-gravels were at one time thought to be derived.

ORIGIN OF THE DIAMOND.

Perhaps it will be best to first state briefly two or three of the various theories which have been advanced:—

1. Sir A. C. Ramsay has urged that the real home of the diamond is in the schistose or gneissic rocks, of high antiquity, which are known to underlie the Kimberley shales, and which in other regions are even more directly associated with diamonds. From the broken and imperfect state in which the diamonds of South Africa are frequently found, it is certain that they cannot have been formed in the exact situation in which we now find them, while the fragments of gneiss which also occur in the mines prove that the diamond-rock must have passed upward through the gneiss.

2. Professor H. G. Seeley has suggested that carbonic acid found its way downward together with the water which (after its conversion into steam) has been shown to be the principal cause of volcanic eruptions. The carbonic acid was decomposed by heat, and then, under great pressure, the liberated atoms of carbon built up the crystalline form of that element known as the diamond.

3. Reasoning from the experiments of Mr. Hannay, it seems not impossible that the diamonds may have been derived from the carbonaceous matter contained in the shales through which the diamond-rock passes. Not from those shales which form the walls of the present mines, but from shales occurring at a greater depth, and through which the intrusive bronzite has previously passed. If this be the case, it is clear that the supply of diamonds will cease when the shales have all been worked through. In any case, the deepening of the mine will shed light upon the problem. Under the great pressure and high temperature to which the hydro-carbons in the shales would certainly be subjected at the time of the outbreak by which the existing pipes of volcanic rock near Kimberley were formed, the hydrogen of these hydro-carbons would be strongly attracted by the metal magnesium which now forms part of the bronzite. The carbon atoms—set free in this way—under the enormous pressure to which the whole mass would then be subjected, might aggregate together to form diamonds.

In any case, it is impossible not to agree with Professor N. S. Maskelyne when he says: "It is possible that carbon, like metallic arsenic, passes directly from the state of a solid into that of a vapour; and that the condition for its sublimation in the form of crystals, or its cooling into the crystal diamond, is one involving a combination of high temperature and high pressure present in the depths of the earth's crust, but very difficult to establish in a laboratory experiment."

Although, in the future, the geologist and the chemist must work together in the interesting task of discovering the mode of genesis of the diamond, yet it is clear that the onus of the direct proof must lie with the latter. In years to come, when the rocks of the diamantiferous regions shall have been mapped and studied as accurately and thoroughly as those of England have been, the geologist will probably be able to accurately locate the diamond in its true home—in the rock in which it was produced. But as to the mode of its origin in that rock, the chemist will have much to say; nor will the proof be considered complete until diamonds are produced artificially with certainty and ease. That they will be so produced the writer of this article considers certain, and if chemists had been able to command the expensive appliances necessary for the performance of the many and intricate preliminary experiments required—experiments which may involve years of failure—it is probable that success would have been attained ere now. When the Edison of Chemistry arrives, artificial diamonds will be successfully made; they will, perhaps, not be so ornamental as those occurring naturally, but there is a wide field of usefulness awaiting such a product in the arts and manufactures.

SOCIETY OF ARTS.—The results of the Society of Arts' examinations have just been published. There was a satisfactory increase in the number of candidates, 1,208 having presented themselves at 44 centres; whereas last year there were 991 candidates and 38 centres. Of these 1,208 candidates 953 passed and 255 failed. The number of papers worked was 1,321; of these 145 took first-class certificates, 410 second-class, and 474 third-class, while to 292 papers no certificate was awarded. Eleven of the thirteen subjects set down for examination were taken up. In two no examination was held, as the requisite number of candidates (25) did not present themselves. The largest number of papers worked (336) was in book-keeping. Other favourite subjects were:—Arithmetic, 171; English (including composition and correspondence and précis writing), 118; shorthand, 253; theory of music, 243. In French there were 96 candidates; in German only 28.

ERRATA.—Delete "such" in column two, p. 462, line two from the bottom. In the review of the "Revised Version of the Bible," p. 463, second line, for "English-spoken races," read "English-speaking races." In "Letters Received and Short Answers," p. 467, in the reply to General Babbage, the concluding sentence should run:—"If the expenditure of £17,000 of the national funds had had no other result than the publication of the chapter on 'Intrigues of Science,' in the work quoted by General Babbage, it would have been deplorable." The name of the maker of the Tandem tricycle, commended by Mr. Browning in letter 1720 (p. 445), should be "Leni," and not "Levi," as there printed. At page 467, column two, in reply to "X.Y.Z.," for "Webb's Series" read "Weale's Series." In the editorial note to Letter No. 1,727, page 466, "eye-pieces" should be "eye-piece."

CHATS ON GEOMETRICAL MEASUREMENT.

BY RICHARD A. PROCTOR.

(*Continued from page* 432.)

THE CONE.

A. Is the cone as easily dealt with as the cylinder?

M. Quite as easily.

A. Will you take first the curved surface of a cone?

M. I can only deal with the curved surface of a right circular cone—the curved surfaces of oblique cones and cones on elliptical bases require the higher analyses.

A. What is the curved surface of a right circular cone?

M. It is equal to a triangle having the circumference of the circular base of the cone for base, and the height of the cone for height.

A. How do you prove this?

M. Let C D B, Fig. 1, be a right cone on the circular base D A B; C A, C B, C D being straight lines from the vertex to different points on the circumference of the base. Then we might divide the whole curved surface of the cone into small areas like C A*a*, and show that each of these approaches in area to a triangle having A*a* for base, and C A for height. Adding all such triangles, we should obtain a triangle having the circumference of the circle D A B for base, and C A for height. But it is simpler to suppose the

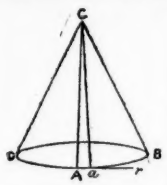


Fig. 1.

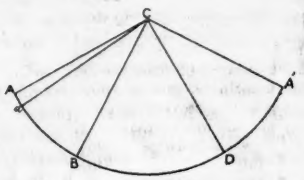


Fig. 2.

cone rolled on a plane, till its whole surface has touched the plane. If the line C A, Fig. 1, touches the plane at the beginning of the rolling, as in C A, Fig. 2, it is obvious that the surface rolled over will be such a sector as C A B A′, where A B A′ is the arc of a circle, round C as centre, rolled over by the circle D A B, and C A, C*a*, C B, C D in Fig. 2 are the lines touched by the correspondingly lettered lines of the conical surface C D B in Fig. 1,—C A′ being where C A of Fig. 1 *again* reaches the plane.

A. As in the rolling of the cylinder, this result of the rolling of the cone seems obvious. But how is it proved that the circular edge of the cone's base will trace out a circular arc?

M. As you begin to roll the cone from contact with C A, it is evident that, as A T, the tangent at A to the circle D A B, is square to C A, the beginning of the rolling starts the trace A*a*, square to C A; and this squareness is maintained throughout. Hence as a circular arc round C as centre, and at distance C A, is the only curve which can pass through A, and be everywhere square to each successive position of the equal generating lines of the cone, as they successively touch the plane, this arc is the trace left by the rolling edge of the circle D A B of Fig. 1.

A. Do you not here assume that the vertex C of the cone will always remain at the same point in the plane?

M. Not actually; for the proof only requires in reality that all the lines in which the rolling cone touches the plane shall be equal, which of course they must be. But, one might assume as self-evident that C will not move on the plane; for C is the trace of a rolling circle of infinitely small dimensions, and such a circle—*i.e.*, a point, cannot in any finite number of rollings traverse a finite distance. It will therefore remain always at the same point C, Fig. 2.

A. We can, of course, now determine the area of a frustum of a cone, such as D *a* B, between two parallel circular sections D A B and *d a b* (Fig. 3).

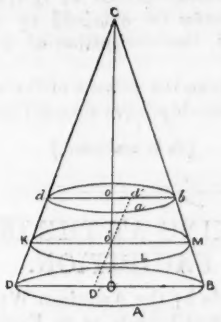


Fig. 3.

M. Yes; the curved area D *a* B is equal to the difference between two triangles, the larger having circumference D A B and height C D, the smaller having circumference *d a b* for base, and height C*d*.

A. Will it not be convenient to express the areas of cones and frusta of cones in terms of the height, radius of base, and the like?

M. It will; for we must remember that the purely geometrical character of our inquiry will not be affected by the use, now, of letters to represent lines, &c.; or by the use of the trigonometrical symbols:—

Suppose first, radius of cone's base to be r, and side of cone to be d.

Then curved area of cone $= \frac{1}{2} \cdot 2\pi r d = \pi r d$.

If height of cone is h, C D $= \sqrt{r^2 + h^2}$, and

curved area of cone $= \pi r \sqrt{r^2 + h^2}$.

If half the vertical angle D C B of cone is a, *i.e.*, $\angle$ D C O $= a$, where O is the centre of the base, and height $= h$, then D O $= h \tan a$, and C D $= h \sec a$;

$\therefore$ curved area of cone $= \pi h^2 \tan a \sec a$.

If we have a frustum, as D *a* B, such that D O $= r$, C O $= h$ and C *o* $= h'$; then $d o = \frac{h'}{h} \cdot r$; and

$$\text{curved area of frustum} = \pi r h - \pi r \frac{h'}{h} \cdot h'$$

$$= \frac{\pi r}{h}(h^2 - h'^2)$$

If half vertical angle D C B $= a$, C O $= h$, and C *o* $= h'$, then

$$\text{curved area of frustum} = \pi h^2 \tan a \sec a - \pi h'^2 \tan a \sec a$$

$$= \pi \tan a \sec a \,(h^2 - h'^2)$$

A. Can we express the area conveniently in terms of its slant side D*d*?

M. Let us see. Suppose as before D O $= r$; C D $= d$, and D *d* $= s$. Then

$$d o = \text{D O} \frac{d\,\text{C}}{\text{D C}} = r \frac{(d - s)}{d}$$

$$\therefore \text{curved area} = \pi r d - \pi r \frac{(d - s)}{d} \cdot (d - s)$$

$$= \frac{\pi r}{d} \left\{ d^2 - (d - s)^2 \right\}$$

$$= \frac{\pi r}{d}(2d - s)s$$

Now, it is easily seen that the circle K L M obtained by

taking a plane midway between $d\,b$ and D B has for radius $\left(d-\frac{s}{2}\right)\frac{r}{d}$, and for circumference $\frac{\pi r}{d}(2d-s)$. Hence the area of the frustum d A b is equal to the rectangle under a line equal to the circumference of K L M and the side d D. This can easily be obtained by an independent geometrical method, the recognition of which I leave to your ingenuity.

A. Let us next take the volume of the cone.

M. We may preferably leave that till next time.

(To be continued.)

WATCH-MAKING AT THE INVENTIONS EXHIBITION.

THE display made by the American Watch Company, of Waltham, Massachusetts, is to English eyes not only very attractive but eminently novel. It may be justly regarded as typical of the general bent of human ingenuity in the States. There the effort clearly is to minimise to the very lowest limit the necessity for hand labour. The causes of this are manifold, not the least being the requirements of a young but energetic country, teeming with resources only very partially developed. We in England have, somehow or other, become so thoroughly imbued with the idea that a hand-made article is so much better, so much more accurate and reliable than one produced by machinery, that it is for us a matter of difficulty to conceive the production of so delicate an appliance as a watch almost solely by mechanical means. Nevertheless, it must be apparent, after due reflection, that any imperfections in machine-made appliances are due rather to inaccuracy and imperfection in some slight detail or design, than to a fault in the principle. It is manifest that a tool which is made to perform certain work with definite regularity must, in virtue of that very autonomy, produce better work on the whole than could be furnished with the unaided hand, susceptible as it is to every extraneous influence that may be calculated to interfere with its efficiency as a tool-directing machine. The exhibit under consideration is one which is calculated to materially modify our impressions, and to convince us that mechanical productions are not to be despised or derided simply because it is impossible to trace by any show of irregularity the evidence of man's direct handiwork. Big, however, as is the show made by the company at the Inventions Exhibition, it is inadequate to demonstrate the vastness of the factory and completeness with which every little detail is attended to. A few remarks on these points may not want in interest to our readers. In the accompanying illustrations, the factory and several branches of the work are depicted. The present buildings were erected in 1878, other and smaller works having been in existence since 1850. Fig. 1 gives a fair idea of the general plan upon which the edifice has been erected. It is built on an expansion of the Charles river at Waltham, and is constructed of bricks. It consists of an extensive range of workrooms, &c., with several long wings and inner courts, designed evidently to secure as much natural light as possible. The building is flanked on the one hand by the offices, and on the other by a well-equipped conservatory, the total frontage being 646 ft., and the floorage nearly five acres. There are upwards of three miles of workbenches. Nearly everything being done by steam power,

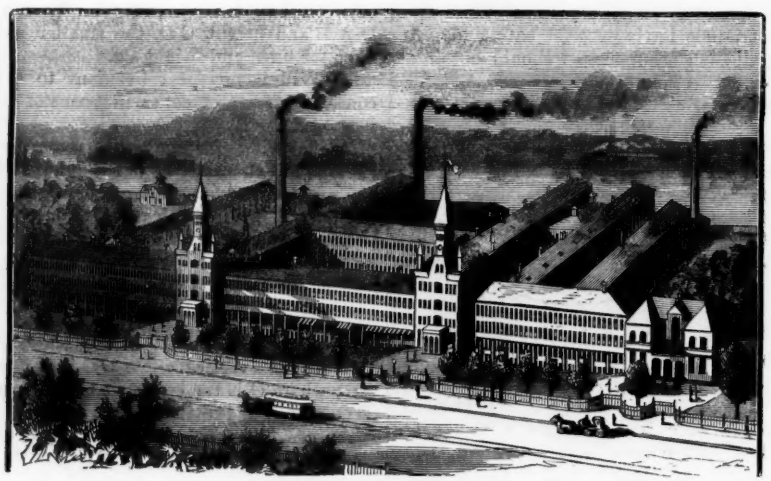


Fig. 1.

a large Corliss engine of 125 horse-power is kept going in the engine-house at the rear. The engine drives 10,600 feet of main shafting, which, by means of pulleys and belting, drive the machinery—in some cases direct, in others by the intervention of 8,000 feet of wall-rods. Altogether, 39,000 feet of belting and 4,700 pulleys are requisitioned. At night-time, or when natural light is insufficient, illumination is afforded by 200 incandescent electric lamps and 3,500 gas-jets, involving 22½ miles of piping. As may be gathered from the illustration, but better still from the well-executed model of the factory embodied in the exhibit, extensive grounds surround the building, every effort being made to maintain them in as attractive a state as possible. Every attention has been paid to the sanitary arrangements, provision having to be made for 2,500 *employés*, who turn out between them nearly 400,000 watches per annum.

The works are divided into twenty-five distinct and, in a measure, independent departments. Each communicates telephonically with the central office. In these departments, each watch undergoes, it is said, no less than 3,746 operations—a fact which few people in this country will be able to realise.

The numerous machines employed are, on the score of accuracy and good workmanship, as well as on that of economy, designed and constructed on the premises; and indeed no effort seems to have been spared to make the factory as independent as possible of other houses. Primarily, the movement of a watch is made up of two plates, and the wheels, &c., between them. The plates are known as the pillar plate and the top plate. In full plate watches the top is wholly closed or covered. The top of a three-quarter plate watch is flush with the balance bridge and about one-quarter of the plate is cut out to allow the planting of the balance—hence the name "¾ plate." All Waltham watches have what is called a going barrel, instead of the fusee, preferred in the English system. The going barrel contains the mainspring, and drives the centre wheel and pinion, which revolve once an hour, carrying the minute hand. The third wheel and pinion are simply intermediate between the centre wheel and the fourth wheel, which carries on its staff the second hand, revolving once a minute. The fourth wheel also drives the escape wheel, so called because it only lets one tooth escape at a time, bringing the machine to a dead stop five times every second. They used to make all watches with 14,400 beats to the hour (or four to the second); this is called "slow train," and is now obsolete except for one-quarter second watches. The English standard was advanced to 16,200 beats to the hour (four and a-half to the second). The Waltham standard is now 18,000 beats to the hour (five to the second), called "quick train." Experiments have also been made up to 21,600 beats to the hour (or six to the second), called "fast train," but results are not satisfactory.

All Waltham watches are provided with "lever escapement." The lever consists of a pallet and fork, and receives an oscillatory movement from the escape-wheel. The balance, to which the lever imparts motion through the medium of the roller jewel passing alternately in and out of the fork, regulates the whole watch. It consists of a comparatively heavy wheel running on an axis with finely-adjusted pivots and with the least possible friction, and a hair-spring attached at one end to the balance-wheel and at the other to the balance-cock, which is fastened to the top plate. The value of the hair-spring is to secure uniformity of vibration of the balance-wheel; the balance is bimetallic, to correct the contraction or expansion of the hair-spring on the degradation or exaltation of temperature.

The minute and hour wheels are located under the dial, and are driven by a system of gearing. The cannon pinion fits friction tight on the centre staff, being so put on to enable the hands to be set. The cannon pinion drives the minute wheel, and the minute pinion drives the hour wheel; the proportion being such that while the former revolves once an hour, the latter revolves once in twelve hours. Most of the watches now made are wound up by turning the crown of the case, and the hands also are set by a similar device, dispensing wholly with the watch-key.

The safety of the movement from any injury that might result from the breaking of the main-spring is secured by a safety pinion screwing on to the arbour of the centre wheel by a triple left hand thread. Should the main-spring break, the recoil would merely unscrew this pinion, and thus release the whole movement without any consequent damage.

The manufacture of the various parts of a watch is carried on in different rooms, each room being set apart for a particular kind of work. Thus, in the plate-room (Fig. 2) the pillar and top-plates are made, the material generally employed being brass. Here as many as 157 operations are performed, 80 of them being in connection with the pillar-plate alone.

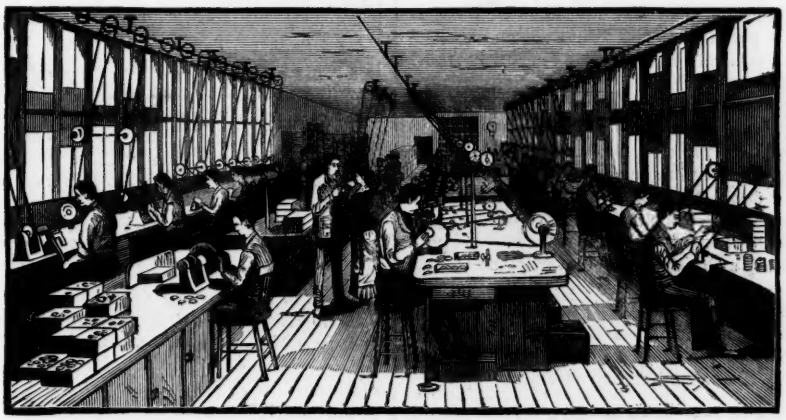


Fig. 2.

(To be continued.)

Editorial Gossip.

THERE are but few amateur astronomers indeed who will not mourn for the death of the Rev. Prebendary Webb, and in some sort feel as though a personal friend had been taken from them. For surely no one during the present generation had done so much to popularise observational astronomy as the late vicar of Hardwick, whose "Celestial Objects for Common Telescopes" is employed as a handbook in nearly every observatory in the kingdom. But, although this is the work with which his name is most widely associated, and by which he will be best remembered, he was, further, a prolific writer in various periodicals on astronomical subjects generally, and we have had the privilege of numbering him among the contributors to our own columns. The gentleness and simplicity of his life were reflected in his writings, with the charm of which so many who will read these lines must be familiar. Latterly,

his visits to London were less frequent than of yore. The last time I ever saw him was in the library of the Royal Astronomical Society, at Burlington House.

IN another column will be found an extract from a letter addressed to the *Launceston Examiner*, by Mr. A. B. Biggs, giving details of his observations of the lunar eclipse of March 30, as seen in Tasmania. The points of interest to be noted are the opacity and slaty tint of the earth's shadow, utterly obliterating all detail on that part of the moon's surface which it covered, and the entire absence of that copper-colour which had become so familiar to observers as to be regarded by them as almost the normal hue of the earth's shadow. Now, it is noteworthy that this red tint was conspicuous by its absence on the occasion of the eclipse of the moon, on Oct. 4 last; whence it would seem that the terrestrial atmospheric conditions then existing must still persist.

CERTAINLY the strange kind of haze surrounding the sun does, as may easily be seen by any one who, on the clearest day, will just hide the sun with his hand so as to be able to regard that part of the sky in which he is situated. With this precaution the illumination of *something* in his neighbourhood will become instantly most apparent; the blue sky 90° from him offering a very marked contrast indeed to it. Learning furthermore that the glorious afterglows (which are obviously connected in some way with this exaggerated pseudo-coronal effect), have returned in their pristine splendour in South Africa, one is again tempted to speculate upon the nature of the very obscure and unusual forces which must have been so persistently at work to produce these joint effects. When I remember, too, that Mr. Neison, the Government Astronomer at Natal, was actually making water-colour sketches of these afterglows in February, 1883, and that now, in May, 1885, they are as beautiful and marked as ever, I would humbly venture to inquire whether it is not almost time that the Krakatoa humbug was given up?

In speaking last week of the curious paucity of cuckoos this year, I quoted from a newspaper the remarkable assertion that "Between 45° 55′ W. Longitude and 41° 44′ N. Latitude (!) unusual and dangerous quantities of ice are floating just." (!) Since then this very much more definite statement has appeared:—

ICE IN THE ATLANTIC.—Washington, May 29.—According to the records of the Hydrographic Office, the amount of ice and the number of icebergs which have appeared in the path of European steamers during the past month is unprecedented.

Of course, every possessor of a telescope must have noticed the indications of activity (including one really splendid spot) which have been visible upon the sun's face during the past month. I wonder how long it will be ere the Committee on Solar Physics—of course, for the benefit of the ignorant—promulgate the doctrine that icebergs are the outcome of great Solar disturbance?

OUR readers will be pleased to learn that the School of Submarine Telegraphy and Electrical Engineering, of which we have on two or three occasions spoken favourably, has been highly complimented by the veteran electrician, Sir William Thomson LL.D., F.R.S., in a testimonial dated 16th ult. A glowing article describing the Institution appeared in Friday's *Daily News*.

Reviews.

SOME BOOKS ON OUR TABLE.

The Geology of Genesis.—By E. COLPITTS ROBINSON, F.R.G.S. (London: Elliot Stock. 1885.)—Reverently but most tolerantly written, and often exhibiting a considerable amount of ingenuity in its argument, we can only say with regret of Mr. Robinson's work that it adds one more to the total failures to reconcile the plain, straightforward details given in Genesis of an imaginary sequence of events, with the irrefragable facts of modern science. Concerning his theology we are perforce silent. No similar reticence, however, is incumbent on us in dealing with his remarkable geology and palæontology and even more remarkable physics. No detailed examination of the work before us is possible within the limits of this notice; nor is it needful, inasmuch as a very few examples taken almost at random will suffice to show the character of what its author mistakes for reasoning. In limine, in connection with Genesis i., 2, "And darkness was upon the face of the deep," Mr. Robinson says, "Our world in its infancy existed in a semi-molten state, covered by a universal ocean, and surrounded by *mineral vapours* (the italics are ours) and clouds of steam;" and proceeding to the consideration of vv. 3–5, goes on to add, "As the globe became less heated and the surface cooler, so the dense vapours standing above the ocean would become less and less heavy. First of all the vapours of the heavier metals settled and solidified; then the lighter metals would cease to exist as vapour; and lastly, the volatile compositions of sodium, phosphorus, and the lightest minerals would assume their metallic form, leaving above and around the world a cloud composed for the most part of steam or vapourised water. At some time during the process of lessening vapour, the clouds would become just sufficiently pellucid to admit of the rays of light falling upon the face of the great deep, *hitherto wrapped in total darkness*" (again we italicise). It is in a kind of blank amazement that we ask whether, before penning this stuff, its writer ever heard that platinum fuses (*i.e.*, becomes not vaporous but merely liquid) at 3,082 Fah.; iron at 2,912 Fah.; gold at 2,282 Fah., and so on? Darkness upon the face of the deep! Why the whole surface (such as it was) of the earth under the conditions postulated must have shone with an effulgence in some sort comparable with that of the sun himself. Again he repeats the hundred times exploded paralogism about the "day" of the narrative being a geological period or epoch, in which he has been anticipated by Mr. Kinns in his notorious work on the same subject. Whatever may be asserted in the nineteenth century, it is abundantly evident that the narrator of the legend believed that "the evening and the morning" were ordinary ones; and that it was upon this belief that the reason given in Exodus xx., v. 11, for keeping the Sabbath was founded. The quibble about seasons and years being "contained" in the fourth day (p. 73) is wholly unworthy of the author. His ideas concerning pre-historic man, the nature of Eve's sin, &c., if not original, possess a certain amount of freshness; but when he speaks of Adam's predecessors possessing "only an animal nature 'like the beasts of the field,'" we can only come to the conclusion that he must be in sublime ignorance of the fifth chapter of so easily accessible a book as Joly's "Man before Metals." We had marked other passages for comment, but our review has already exceeded its prescribed bounds. It would have pleased us to record our belief that Mr. Robinson had proved his thesis. It only remains to regret

that he has added one more to the mass of failures which have done such irreparable injury to the cause which they were intended to defend.

A Catalogue of Suspected Variable Stars. By J. E. GORE, M.R.I.A., F.R.A.S. Dublin: Ponsonby & Weddrich.)—This practically exhaustive catalogue of stars which are on good grounds suspected of variability forms an indispensable supplement to that of the 191 "known variable stars," of which we were able to speak in terms of such sincere commendation on p. 243 of our VIth volume. In Mr. Gore's present work he arranges the subjects described in their order of right ascension, giving their R.A. and Dec. for the year 1880. Following these co-ordinates is a column in which the supposed changes of magnitude are tabulated; which is itself succeeded by another giving the name of the authority for the asserted variability. With a short exordium (explaining the notation employed and the methods by which the various data given have been obtained) this catalogue occupies 43 pages, the remaining 115 which go to complete the volume being occupied by a series of most valuable notes upon the different objects described. A map of all known and suspected variable stars forms the frontispiece. Every observer of the mysterious bodies with which Mr. Gore's excellent work deals will, merely as a matter of course, obtain it at once.

Studies in Microscopical Science. Edited by ARTHUR C. COLE, F.R.M.S. Vol. III. Secs. 1, 2, 3, and 4. May, 1885. (London: Baillière, Tindall, & Cox.)—But little remains to be said here beyond the acknowledgment of the usual monthly instalment of Mr. Cole's admirable and instructive work, which continues to sustain its well-earned reputation. No working microscopist can possibly afford to be without it.

Text-book of Entomology. By W. F. KIRBY. (London: W. Swan Sonnenschein & Co. 1885.)—There are few branches of Natural Science which commend themselves more to the beginner than entomology. Universally distributed as insects are, the incipient entomologist finds objects and material for study wherever he may be situated; while, as his knowledge of his subject increases, he is brought face to face with nature in her most delightful aspects in his search for fresh specimens for collection and investigation. Moreover, it is a branch of study which it costs comparatively nothing to pursue; so that it is not, like some others, a monopoly of the well-to-do. A better introduction to this fascinating science than that provided by Mr. Kirby it would be difficult to find; in fact, it is a kind of succinct cyclopædia of the subject. Plain and perspicuous in language, and profusely illustrated (by more than 650 figures), the insect must be a rare one indeed whose genus—and perhaps even whose species—the reader fails to determine without difficulty from these pages. We are glad to see that our author reduces Westwood's Mass of Orders to seven only—viz., Coleoptera, Orthoptera, Neuroptera, Hymenoptera, Lepidoptera, Hemiptera, and Diptera. The woodcuts are so admirable as almost to cheat the eye familiar with the objects represented into the belief that it is gazing upon the colours which it knows so well; though in reality, of course, all is in black and white. Advanced entomologists will obtain Mr. Kirby's fine volume as a handy book of reference. The student will buy it as an excellent introduction to the science, and as an absolutely trustworthy text-book.

Origin and Reproduction of Animal and Vegetable Life on our Globe. By THOS. SPENCER, F.C.S., F.R.M.S., &c. (London: Effingham Wilson. 1885.)—Suboxide of iron, and nothing else, is, according to our author, the prime agent in the origin and maintenance of life on the earth. How this nearly universal substance acts will be found set forth in Mr. Spencer's pamphlet.

Reports of the East of Scotland Union of Naturalists' Societies (1885.)—This volume consists of a series of reports of the various sections of the Federation of Natural History Societies in the Eastern Counties of Scotland, setting forth what has been done in the various departments of natural science, and pointing out exactly what yet remains to be accomplished. The reports proper are preceded by a very able and eminently-practical inaugural address by Dr. Buchanan White, the President of the Union.

Mimosis Inquieta. By EDWIN WOOTON. (London: Baillière, Tindall, & Cox.)—The curious disorder whose nature and ætiology are discussed in the able and original little tract before us is probably more familiar to most of our readers under the names of hysteria in the female and hypochondriasis in the male subject, than under the somewhat bizarre-looking one under which our author describes it. The object of Mr. Wooton's book is to show how certain psychical phenomena have their origin in purely physical causes. The medical man and the layman alike may profitably study what is here set forth on a subject so obscure as that of nervous debility, whose very obscurity has caused its comparative neglect by physiologists in general, and the ignorance of the facts in connection with which has been traded upon by the very vilest and most degraded of quacks.

Practical Organic Analysis. By GEORGE E. R. ELLIS. (London: Longmans, Green, & Co. 1885.)—Primarily intended for medical students—in fact, compiled as a text-book for the first M.B. examination Mr. Ellis's little book should really address a much larger public. The pleasure and instruction derivable from experimenting in inorganic chemistry are familiar to multitudes, who may learn from the work whose title heads this notice that organic chemistry is not inferior in fascination to that better-known branch of the science. The fourth section, on the "Detection of Simple Poisons in the Presence of Organic Matter," must interest every one having any concern in medical jurisprudence.

Physical Expression. By FRANCIS WARNER, M.D. International Scientific Series, Vol. LII. (London: Kegan Paul, Trench, & Co. 1885.)—Full of matter of grave import to the physiologist, psychologist, pathologist, and anthropologist, this work of Dr. Warner's is written in so dry a style as materially to impair its chance of being studied as it really deserves to be. That the subject of the expression of the emotions, though, may be rendered interesting and readable, we have only to turn to the works of Bell or of Darwin to discover. Dr. Warner's volume embodies the result of a vast amount of scientific investigation, and of hard and honest work, the details of which, however, he contrives to give with a sort of monotony, and even level of dulness, which cannot fail to render it unattractive to the general reader. This is to be regretted, inasmuch as, as we began by hinting, there is so much in it which merits careful study. All who are content to condone a prosy manner for the sake of the valuable matter set forth in it should get Dr. Warner's volume.

Annual Reports of the Aëronautical Society of Great Britain for the Years 1883–4. (London: Hamilton & Co.)—The Aëronautical Society (which is by no means to be confounded with the Balloon Society) is apparently proceeding in a hopeful, but thoroughly practical spirit, in its attempt to solve the problem of aërial navigation. There is much that is interesting in the pamphlet before us, and those who wish to gain some idea of the existing condition of Aërostatical Science (or more properly Art) may obtain

no little information from it. From another brochure which accompanies it we learn that the Society is about to hold an Aëronautical Exhibition at the Alexandra Palace, opening on June 15. The readers of the "Reports" on which we are commenting will probably feel tempted to supplement the theoretical information they will gain from them by an inspection of the most recently-devised apparatus for flying.

The Voyager's Companion and Adviser. By HENRY JOHN WEBBER. (London: The Author.)—This is as plain and practical a little guide as any one can possibly desire, and will repay its trivial cost a dozen times over to the traveller about to make his first voyage without a superabundance of cash. Our author explains the relative advantages and disadvantages of sailing vessels and steamers; gives instructions for selecting your ship, and, subsequently, your cabin and berth on board of her. Tells you what to take for cabin furniture, what clothes to provide yourself with, and how to amuse yourself at sea. He further gives a popular description of the various parts of a ship, of the compass, &c., and of some of the simplest nautical manœuvres. Then the question of weather is discussed, and the sights and phenomena of the open ocean described. Finally, those who suffer from sea-sickness will find a remedy for that affliction set forth at length in Mr. Webber's pamphlet.

William Hedley, the Inventor of Railway Locomotion on the Present Principle. By M. ARCHER. Third Edition. (London: Crosby Lockwood & Co.)—If the question were put in any assembly of educated Englishmen, "Who was it who invented the locomotive-engine running upon smooth rails?" something like ninety-five per cent. would answer "George Stephenson," without any hesitation whatever. And yet, manifold as were the services rendered by Stephenson to mechanical science, and intimately indentified as his name is with the inception of our railway system, he did not, after all, invent locomotion on the present principle; inasmuch as William Hedley, the "Viewer" at Mr. Blackett's Colliery at Wylam (a town to the west of Newcastle-on-Tyne), in May, 1813, had a locomotive running on smooth rails on the Wylam Railway, and Stephenson's first engine (which failed) was not tried at Killingworth for a year afterwards. All interested in the history of locomotion should read Mr. Archer's reclamation for Hedley.

Moffatt's Penny Atlas. Fifty-five Maps and Diagrams. (London: Moffatt & Paige.)—This is one of the most astonishing pennyworths that has come under our observation for many a long day. If they are not overburdened with detail, the maps, at all events, are legible and correct. Certainly no one is justified in pleading ignorance of geography who has a penny in his pocket to buy this little book with.

The Pictures in 1885, *and the Men who Paint them.* (London: *Pall Mall Gazette* Office)—This remarkably cheap and artistic work is sufficiently catholic, comprising, as it does, sketches of the leading pictures in the Royal Academy, the Grosvenor Gallery, the Society of British Artists, the Royal Society of Painters in Water-Colours, and the Royal Institute of Water-Colour Painters. These are prefaced by a series of portraits and autographs, with views of the studios of our most renowned painters. It is a book to be studied and kept.

A Brief and Practical German Grammar, for the use of Science Students. By EMIL BEYER. (London: David Nutt. 1885.)—So much that is valuable to the student of science lies enshrined in German, that he labours under the gravest disadvantage should he be ignorant of that language. As an introduction to its study, Herr Beyer's Grammar may be confidently recommended, breaking, as it does, fresh ground in more than one direction. The new German spelling is treated of at an early stage of the work, and the second part (the Reader) contains essays on the Theory of Heat, the Physical Cause of Colour, the Construction of Galvanometers, Chemical Analysis, Animal Electricity, and cognate subjects. A very complete vocabulary of technical words concludes the volume, which will doubtless obtain the extensive circulation which it certainly deserves among those to whom it is primarily addressed.

The Great Crisis at Hand. By Rev. M. BAXTER. (London: *Christian Herald* Office.)—It is not easy to understand what kind of public such utter raving as this addresses. Let us sincerely hope that the great crisis at hand, so far as any believers in it are concerned, will in no way be connected with the Statute 16 & 17 Vict. c. 97 s. 68.

The Thirty-nine Articles of the Church of England; the Ninth Article, Hamartiology. By Rev. JOSEPH MILLER, B.D. (London: Simpkin, Marshall, & Co. 1885.)—Why the work whose title heads this notice should have been sent to a scientific journal for review we confess our inability to understand. As may be inferred from that title, it is a Theological one purely and simply. How far the connection between sin and physical death may be a legitimate subject for scientific discussion, need not detain us here. It would be impossible to advert to this portion of Mr. Miller's argument without being led into much that would be utterly foreign to our purpose. But our inability to criticise the work before us in its theological aspect need not prevent us from saying that the amount of out-of-the-way learning and research on the part of its author exhibited in its pages is really wonderful; and that any one desirous of studying the archæology of the ninth clause of the Church's Confession of Faith may advantageously do so in this volume.

Imperial Federation. By the RIGHT HON. THE MARQUIS OF LORNE. (London: Swan, Sonnenschein, & Co. 1885.)—That the British Empire, including, of course, in that term her colonies and dependencies, should become one stupendous whole, and that our fellow-subjects in Canada, Australia, &c., should enjoy equal rights of citizenship and equal responsibility with the inhabitants of these islands, is the dream, or plan, or project which Lord Lorne sets himself to develop. He discusses suggested plans for Federation, and gives his own views as to the most feasible way of accomplishing it. His idea, however, presumably founded on personal experience, that Canada is ripe for federation, must have received something of a shock upon the perusal of the following paragraph, which appears in the papers as we write these lines:—

> A banquet has been held by the "National Club" of Montreal, at which many members of the provincial Parliament were present. The toast of "The Queen" was drunk in silence. The Mayor of Montreal and six provincial Mayors responded to the toast of "The Independence of Canada," which was received with enthusiasm. Imperial federation was declared to be impracticable; any further federation must be with the United States. The object of the proceedings was to traverse the assertion that no prominent public men favour these views.

The noble Marquis heads his third chapter, "Go Slow." This is going *very* slow in the direction of that federation which he apparently so confidently anticipates.

The House of Commons on Stimulants.—By the author of "Study and Stimulants." (London: John Snow & Co. 1885.)—The author of this tract just succeeds in making teetotalism ridiculous. He concludes by saying that "there is nothing like a concensus of opinion among Members of Parliament in favour of abstinence"; having previously

informed us that (according to Mr. B. Whitworth) there are 36 abstainers in the House—*i.e.*, 36 out of 652, or ·055 of the whole number! "Consensus of opinion!" If there be anything approaching to it, it is out of all proportion in favour of moderate drinking. Moreover, we should like to know whether men like Mr. Passmore Edwards, who *was* a total abstainer, but has now returned to a more rational frame of mind, are to be included among the 36? As for Mr. John Bright, he may, for aught we know, not drink alcoholic liquors; but his smoking is a notorious fact; while in the majority of cases adduced by Mr. Reade, his shining examples range from respectable mediocrity to the veriest dummyism. As adding weight to his argument, they remind us of nothing so much as the inclusion of the name of the man who keeps the "Food of Health" shop among those of "eminent men who have embraced vegetarianism!" Because our author is virtuous, it is a little hard upon the overwhelming majority of Englishmen that there are to be no more cakes and ale. "The pump, the whole pump, and nothing but the pump" is not a sentiment that will ever commend itself to the inhabitants of the United Kingdom.

Think! A Reply to Lord Bramwell's Plea for "Drink." By DAWSON BURNS, D.D. (London: National Temperance Publication Depôt).—We have most carefully read Dr. Burns's pamphlet through from beginning to end, with the result, however, of wholly failing to find that it touches Lord Bramwell's argument at all. Drink is productive of evil, say the total abstainers. Undoubtedly it is; but so are fire and other things, which are also of the greatest possible value to mankind. That a relatively small proportion of the population of this country is led into want and crime by intemperance is unhappily true, but is that any reason why the moderate man should deny himself his couple of glasses of champagne, his pint of claret, or his glass of "Bass?" It would be as logical and consistent to contend that because some one over-insures his house and then burns it down, no one else is ever to light a fire during the entire winter! Moreover, evil as is the effect of alcohol on individuals, the alcohol-drinking races have been the conquerors of the world; and wherever they have come into contact with a purely water-drinking people, like the degraded Tasmanians, the latter have disappeared from the face of the earth. The ancient Athenians were at the very summit of intellectual power, and, according to Aristotle, they were notorious drunkards. If a man is such a weak and fatuous creature that he cannot take sufficient drink without taking too much, by all means let him (like the girl in the ballad), get "a bunch of blue ribbons to tie up" his erring body with, and take all the pledges that can be administered to him. But that another, who was never drunk in his life, should be deprived of the power and right to take what he feels to be at once pleasant and beneficial to him, because there happens to be ever so small a majority of abstainers in any particular district, appears to us to be the grossest possible infringement of the liberty of the subject.

The Making of the Home: a Reading-book of Domestic Economy. By Mrs. S. A. BARNETT. (London: Cassell & Co.)—This is a book which we should be glad to see in the hands of the wife of every artificer, labourer, and even little tradesman in the kingdom. Writing in the plainest language and with the most studious regard to the wants and capabilities of those whom she addresses, Mrs. Barnett has contrived to pack an amount of information into the sixty short chapters or readings which make up her book that is really wonderful. The choice, structure, furnishing, decoration, and cleansing of the house occupy the first eight chapters. Then food and drink, their cost, preparation, and nutrient qualities form the subject of the succeeding thirteen. Cleaning, washing, and clothing (with an incidental dissertation on tallymen and pawnbrokers) bring us up to chapter 34, after which five are devoted to cookery proper. Chapters 41 to 51 deal with hygiene; the succeeding two contain hints on taking pleasure; while education, thrift, the choice of friends, &c., are treated of in the concluding essays. Philanthropists who wish to confer real and lasting benefit upon the working population of Great Britain may take an effectual step in that direction by sowing Mrs. Barnett's compendious little Domestic Encyclopædia broadcast among them—and seeing that they read it.

Practical Problems and Lines for Working Drawings. (Manchester: Abel Heywood & Son. London: Simpkin, Marshall, & Co. 1885.)—The value of the possession of the power of mechanical drawing to artificers of every kind is enormous, and the craftsman who can employ a T-square, a pair of compasses, scales, and a parallel-ruler to make a working-drawing of any job in hand has an advantage over his fellows which it would be difficult to over-estimate. It is to impart the practical knowledge needful for this purpose that the capital little work before us is written. Nothing can be plainer or more perspicuous than the language of its descriptions, which are illustrated by no less than 130 figures. This is a book to be obtained by every one, be he mechanic or amateur, who has to work to scale.

Kotaka. A Japanese Tale. By J. MORRIS. (London: Wyman & Sons. 1885.)—Told in simple language, and destitute altogether of the sensational element, Mr. Morris's story is at once interesting and valuable as giving a faithful portraiture of the inner life of the Japanese. The loves of the old Samurai Hashimoto's daughter Kotaka and the young cadet (and eventually distinguished officer) Genjiro form the thread on which are strung picturesque descriptions of the physical geography, manners, and customs of Japan. To all who may wish to enter upon comparatively untrodden ground, and to learn something of the progress of a strange Eastern civilisation, in an agreeable and readable form, we can confidently recommend "Kotaka."

The Little One's Own Coloured Picture Paper. Edited by Mrs. ELIZABETH DAY. (London: Dean & Son. 1885.)—Yet another candidate for nursery favour; and, judging from No. I., likely to secure the suffrages of the tiny folk. The coloured pictures are capital, the letterpress well adapted to the juvenile public it addresses, and the price very moderate indeed.

Cassell's Readable Readers: First Infant Reader, Second Infant Reader, First Reading Book for Standard I., and *Second Reading Book for Standard II.* (London: Cassell & Co.)—This series of readers, issued by the Messrs. Cassell & Co., seems well adapted to its purpose. The successive little volumes are of slightly increasing difficulty, the subjects are well chosen, and, joy of joys! there are no depressing attempts to be funny. Their compiler or compilers has (or have) certainly succeeded in making a selection which will interest the little ones.

We have also on our table from Messrs. Cassell & Co. *European Butterflies and Moths, The Library of English Literature, Cassell's Household Guide, The Book of Health, The Countries of the World*, and *Cassell's Popular Gardening*; also *The Tricyclist, Wheeling, The Medical Press and Circular, The Dyer, Bradstreet's, The Sanitary News, The Season, The Science of Sanitation* (by Sharp & Co.), *Naturen, Night and Day, Society*, and *The Coöperative Index to Periodicals.*

XUM

THE FACE OF THE SKY.

FROM JUNE 5 TO JUNE 19.

BY F.R.A.S.

THE spots which continue to appear on the sun are now smaller and scarcely so numerous as they have been; but as there has quite recently been a beautiful display of them, his surface should be watched on all fine days. Map VI. of "The Stars in their Seasons" depicts the night sky. Twilight persists all night long now. Mercury *may* be caught as a morning star at the beginning of the period to which our notes refer, but will scarcely be seen during the remainder of it. Venus is an evening star, and, as she does not set until more than an hour after the sun during the second week of the succeeding fortnight, she may probably be picked up without much difficulty. She is becoming gibbous in the telescope. Jupiter, to be seen to any advantage, must be looked at immediately the twilight deepens sufficiently. He sets about half-past eleven at night by the 19th. The visible phenomena of his satellites are naturally becoming fewer. To-night Satellite I. will be occulted at 10h. 43m. On the 6th Satellite I. will pass off the planet's face at 10h. 22m. p.m. On the 13th the same satellite will begin its transit at 10 o'clock at night, and on the 14th reappear from eclipse at 10h. 37m. 11s. p.m. Lastly, on the 16th, Satellite IV. will be eclipsed at 10h. 24m. 57s. We have omitted all phenomena not certainly visible. Saturn is absolutely invisible. Uranus remains practically stationary between β and γ Virginis. The Moon enters her last quarter 4·8 minutes after midnight to-night; is new at 10 h. 42·1 m. p.m. on the 12th, and enters her first quarter at 1 h. 48·5 m. in the afternoon of the 19th. There are no visible occultations of stars during the next fourteen days. When our notes begin the Moon is in Aquarius, but at 2 o'clock to-morrow morning enters Pisces. She is travelling through this great constellation until 7 a.m. on the 9th, the interval between which and 3 o'clock the next afternoon she occupies in crossing the N.W. corner of Cetus. At the last-named hour she enters Aries, where she continues until 9 p.m. on the 10th, passing then into Taurus. In her journey through Taurus she, at 5 a.m. on the 13th, arrives at the western boundary of the northern strip of Orion, on leaving which, twelve hours later, she enters Gemini. She passes out of Gemini into Cancer at 4 a.m. on the 15th, and quits Cancer for Leo at 3 o'clock the next afternoon (that of the 16th). She descends from Leo into Sextans at 9 p.m. on the 17th, re-emerging at 5 h. 30 m. a.m. on the 18th in Leo. She finally quits Leo at 5 a.m. on the 19th for Virgo. We there leave her.

THE LUNAR ECLIPSE OF MARCH 30.

THE following extract from a communication of Mr. A. B. Biggs to the *Launceston Examiner* (a Tasmanian newspaper) of April 1 is not without interest. At the middle of the eclipse its magnitude was 0·88 (the moon's diameter = 1):—

"Now, although the eclipse of last night was not total, it was so nearly so as to be of very considerable interest in relation to its appearance in shadow, and I laid myself out for three hours' observation with special reference to this question. I commenced observing shortly after midnight. The penumbra was then gradually creeping over the south-east limb, though more apparent to the naked eye than in the telescope. The ruggedness of this portion of the moon's surface was at this time distinctly visible even in the profile of the full orb (in the telescope, of course). At 0h. 48m. this ruggedness vanished on the approach of the shadow, and seven minutes later this portion of the outline itself was lost. As the shadow advanced, that part adjacent to each limb appeared considerably lighter than the general shadow. At this time, about fifteen degrees of the moon's limb on each side was visible within the shadow, increasing during the middle of the eclipse to about 25 degrees; this portion of the edge appearing as a sharp line of light, gradually fading away into the shadow. With the above exception, all within the shadow was utterly obliterated—lost in the dead slaty tint of the sky. I could not distinguish a single crater after once it was fairly within the shadow. Not the slightest trace of the coppery tint was visible throughout."

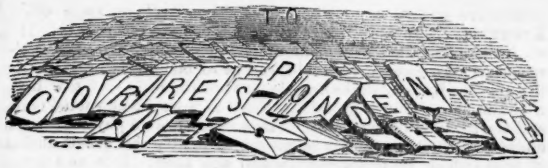
A MATHEMATICAL THEORY OF EVOLUTION.

THE following is the kernel of Mr. Cave Thomas's lecture on "The Bases of a Science of Æsthetics," which has not only an immediate bearing on the subject treated, but on the entire aspect of scientific thought. In reply to the question, "What were the bases of a science of æsthetics?" he said:—"His audience were perhaps aware that philosophically it was a well-recognised fact that we know nothing of the external world absolutely *per se*, but only phenomenally, or as it appears to us in sense. We had, therefore, to ask ourselves whether there be any common and fundamental characteristic of those phenomena. Speaking more immediately with reference to the sense of sight, the knowledge of external existence comes to us by means of the telegraphy of vibrations, which impresses miniature imagery on the retina. We never even "see things," as we express ourselves, of their actual, but only in their relative proportions; and when we come to analyse the different kinds of impressions on the sense of sight we find that they are manifested in the three fundamental modes of consciousness—viz., in space, in time, and in force; and the important truth to be deduced from this is that these three modes are alike quantifiable, that is to say the terms *more*, *less*, *equal*, &c., were producible of the three modes; differences in the sensations of light, colour, are therefore fundamentally *quantitative*, or proportional differences, differences in light and shade are also fundamentally *quantitative*, or proportional differences, and so also are differences in the configuration and superfices of visible images. It may be perceived, then, that the *form* of all visual phenomena is *quantitative*. Hence the conclusion that all the relations of phenomena, recognised by the sense of sight, whether pleasing or displeasing, are fundamentally proportional relations and the science of æsthetics, a science of definite proportional relation—that is to say, the beautiful in form, in colour, and in light and shade consist in those definite proportional relations which are apposite to the sense of sight to the eye, and these it is the aim of a science of æsthetics to formulate. The lecturer, however, has not limited his investigation to the sense of sight; he has analysed the phenomena of the other senses, and has been led to make the following important generalisation, which he believes will affect the whole future current of human thoughts, viz., that the *form** of phenomena, of experience, of knowledge is *quantitative*. If this be a correct generalisation, then *adaptation to purpose*, *fitness*, resolves itself into adaptation of proposition to purpose; *evolution*, *development*, into the becoming of the proportioned in all things†; *politics*, into the proportioned adjustment of material interests, and of social relations; *ethics* into the science of proportioned conduct; *hygiene* into the science of proportioned living; *education* into the science of training and developing a proportioned or beautiful race; *asthetics* into the science of proportioned taste; and *fine art* into proportioned art. Mr. Thomas has completed a work treating all the above subjects fully on this mathematical basis.

SAFETY OF IRON PILLARS IN CASES OF FIRE.—We stated some time since that, owing to the upper stories of a building in Berlin falling in during a fire by the giving way of cast-iron pillars, the Prussian police authorities had issued an edict forbidding the use of cast-iron pillars in any inhabited building, but permitting the use of wrought-iron pillars. Cast-iron may only be used provided that each pillar is surrounded by a fixed casting of sheet iron, in such a manner that there is a good air-space between the two. This edict has provoked much criticism and opposition, and several authorities have reasoned against it, as well as made experiments to disprove the assumption on which it is based. Professor Bauschinger, of Munich, recently made a long series of actual trials with pillars of both cast and wrought-iron. He loaded them with the weights that they are usually allowed to bear in buildings, and heated them first to 300 deg. Cent., then to 600 deg. Cent., and finally to a red heat, and let a stream of cold water play on them, exactly as would be the case in a fire being extinguished by fire-engines. The cast-iron pillars were much damaged and cracked by this treatment, but continued to carry their loads quite safely, while those of wrought-iron were much bent before redness was reached, and so twisted when cold water was squirted on to them that they could not carry their loads. The conclusion is that cast-iron is really far safer for buildings than wrought. Pillars of other materials were also experimented with—viz., natural stone, brick, and concrete. The latter stood the test best, resisting a fire of three hours' duration. Also pillars of ordinary brick stood very well, but granite, sandstone, and other natural stones did not show as much resistance. If the obnoxious edict of the Berlin police has done no other good, it seems at least to have set a good many people to work on this important subject.—*Engineering*.

* *Form* is here used in its philosophical sense, and as implying that of whatever other attribute we can divest experience, we cannot divest it of the attribute of quantity.

† Evolution in man includes the proportioned development of the body, of the sense, and of the intellect. The proportioned is the goal of nature.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THERE IS NOTHING "NEW" UNDER THE SUN.

[1733]—I would recommend "Hallyards" to peruse that remarkable work of Mr. Volney, the famous Assyrian traveller, and member of the National Assembly of France of 1789, viz., the "Ruins of Empires," which treats most impartially of the origin of all the most noteworthy ancient religious systems, &c. If not transgressing your rule, I will note what seems to me the idea aimed at by "Hallyards," showing that there is nothing new in his "ultra gas," otherwise ether; viz., on p. 235, he (Volney) says]:—"In the system of the first spiritualists, the soul was not created with or at the same time as the body, in order to be inserted in it; its existence was supposed to be anterior and from all eternity." Such, in a few words, is the doctrine of Macrobius on this head. Tom, Leip. *passim*. He says:—"There exists a luminous, igneous, subtle fluid, which, under the name of ether and spiritus, fills the universe. It is the essential principle and agent of motion and life—it is the Deity," &c., &c.

Again, p. 158: "Some made this agent the igneous principle, the acknowledged author of all motion; others made it the fluid called ether, because it was thought to be more active and subtile; now, as they always reasoned by comparison, and denominating the vital and motive principle in animals a soul, a spirit, and particularly in comparison with human existence, they gave to the motive principle of the whole universe the name of soul, intelligence, spirit; and God was the vital spirit, which, diffused through all beings, animated the vast body of the world. This idea was sometimes represented by You-piter, essence of motion and animation, principle of existence, or, rather, existence itself; or, at other times, by Vulcan or Phta, elementary principle of fire, &c.—*Vesta Krepte, &c.*

As a consequence from this system, every being containing in itself a portion of the igneous or ethereal fluid, the universal and common mover, and that fluid, soul of the world, being the deity, it followed that the souls of all beings were a part of God himself, partaking of all his attributes, that is, being an indivisible, simple, and immortal substance; and hence is derived the whole system of the immortality of the soul, which, at first, was eternity, &c.

F. W. H.

CONVENTIONAL DARWINISM.

[1734]—I know I am rather heterodox on this subject, at least *pendente lite*, but I also know your love of fair play; and, therefore, I trust you will admit my thoughts, such as they are, upon it.

Hardly a week passes but what I can find something in KNOWLEDGE which confirms my suspicion of the theory of evolution—at least, of natural selection; though I do not doubt the operation of that as one of the wheels within wheels.

Take the case of the cocooning spider. What right have we to assume that this creature (like all others, according to the Darwinians) "acquired" its structure, capacities, and habits? What right have we to assume that all things began wrong, and only, so to speak, jumbled right? That is the weak point of Darwinism, more so than what the German savant adduces, viz., that Darwin assumes all beings to be imperfect.

How much lower do the Darwinians want to go? If they take the lowest organism known—say, a spore of lichen or speck of jelly, for instance—they find the same mysterious (*vide* "George Eliot!"), nay, divine fitness; and the lichen spore is the lichen spore now. It does not evolve; and it is so low down that, when the biological bigots of this latest sect still demand that we should postulate and grant their common progenitor—he really is too convenient—we are inclined to laugh.

Does not the spider, *e.g.*, look "very like" an automaton? Who could have fabricated from the first as he does now, who now fabricates not by virtue of "inherited memory" (how did the first manage?), but by virtue of that unconscious reason (generally termed instinct), which lives, moves, and has its being (the I AM) in the animate or less than inanimate world, which manifests itself in the masks of all form, which is all-incarnate.

Here is my point: the (so-called) elements, *e.g.*, have their attributes and affinities, their natures and fitness, properties and proprieties just as much as living beings, yet *they* have not "acquired" their qualities per heredity and struggle for existence. What they are they are per *law* (the transgression of which—and not of "*the* law"—is sin), and so is all.

The soul of Darwinism, the open sesame of the epoch, is continuity, but the Darwinians violate this, their own first and last commandment, by trying to account for beauty and fitness by natural selection, only on *this* side of the line; stopping short at the inorganic world.

They reiterate over and over again that we *must* accept their theory or admit independent creation (by a willing Creator); but there is another hypothesis, namely, what I am wont to term self-existence, self-design. Matter, with its laws (dis-assuming Berkleyism), always was and always will be a self-existence, self-design, by virtue of the same power (same I AM of All). Organic matter may likewise live and move and have its being.

COMMENTATOR.

THOUGHT-READING.

[1735]—I have read with much interest Mr. Munro's letter [1710] upon the above subject; but while I fully agree that certain of the phenomena of "thought-reading" are explicable upon the muscle-reading hypothesis, there are certain classes of cases where such a theory is quite untenable.

I gather from Mr. Munro's letter that he is not acquainted with the researches of the Society for Psychical Research upon this subject, otherwise he would not have omitted all notice of a most curious class of instances of thought-reading—or, as it should perhaps be called, "thought-transference"—that class of instances, namely, where *pictures* are transferred from the mind of one person to that of another without any recognisable communication by means of the ordinary senses.

In order to show what care was taken to render such communication impossible, I cannot, I think, do better than quote the account of the *modus operandi* of the committee appointed to consider the subject when they were conducting a series of experiments:—"The percipient, Mr. Smith, is seated blindfolded at a table in our own room; a paper and pencil are within his reach, and a member of the committee is seated by his side. Another member of the committee leaves the room, and, outside the closed door, draws some figure at random. Mr. Blackburn, who, so far, has remained in the room with Mr. Smith, is now called out, and the door closed; the drawing is then held before him for a few seconds till its impression is stamped upon his mind. Then, closing his eyes, Mr. Blackburn is led back into the room and placed standing or sitting behind Mr. Smith, at a distance of some two feet from him. A brief period of intense mental concentration on Mr. Blackburn's part now follows. Presently, Mr. Smith takes up the pencil amidst the unbroken and absolute silence of all present, and attempts to reproduce on paper the impression he has gained. He is allowed to do as he pleases as regards the bandage round his eyes. Sometimes he pulls it down before he begins to draw; but, if the figures be not distinctly present to his mind, he prefers to let it remain on, and draws fragments of the picture as they are perceived. During all this time, Mr. Blackburn's eyes are, generally, firmly closed (sometimes he requests us to bandage his eyes tightly as an aid to concentration), and, except when it is distinctly recorded, he has not touched Mr. Smith, and has not gone in front of him, or in any way within his possible field of vision, since he re-entered the room."—("Proceedings of the Society for Psychical Research," Vol. I., p. 162.)

Under these conditions, four of the recognised "gateways of knowledge"—taste, smell, touch, and sight—were completely closed; the sense of hearing alone remains. But it is difficult to see how, unheard by the investigating committee, any signals could pass between the agent and the percipient which would be sufficient to show the form of the pictures which were to be transferred from the mind of the agent to that of the percipient.

Under these conditions, several series of experiments have been

made which, it seems to me, conclusively prove that a picture can be transmitted from the mind of the agent to that of the percipient by some other means than by the five "recognised gateways of knowledge." The pictures obtained in this way are not, of course, absolutely correct; but there is always a general, and sometimes a very close, resemblance between that thought of by the agent and that drawn by the percipient. This will be clear from a careful study of the pictures published in the "Proceedings of the S.P.R.," a few of which will be found in KNOWLEDGE, Vol. II., pp. 364, 365.

Upon one occasion, in order to remove all doubt as to possible auditory communications, the committee "stopped Mr. Smith's ears with putty, then tied a bandage round his eyes and ears, then fastened a bolster-case over his head, and over all threw a blanket, which enveloped his entire head and trunk." The result in this case was very good.

Muscle-reading can hardly account for such phenomena as these. And we seem cast back upon a purely thought-reading hypothesis. Now that which is subjectively thought, is objectively a condition of matter—a motion of the particles of which different portions of the brain are composed. And the process known subjectively as thought transference might on its objective side be stated thus:—One portion of matter in the condition known as thought can so influence another portion of matter, which is of a similar nature and composition, as to place it in a similar condition. Surely there are certain kindred phenomena in the world of physical science which may at any rate lead us to admit the possibility of the thought-reading hypothesis being the true one. A. FOUNTAIN.

[Premising that I have not read "The Proceedings of the Society for Psychical Research," and am hence ignorant whether the Mr. Blackburn to whom Mr. Fountain refers is a member of its committee, or whether Mr. Smith and he always act together, and have been jointly imported by the Society *ab extrâ* for experimental purposes, I would just remark that, if the latter be the case, M. Verbeck's performances with his subject, Mdlle. de Marguerit, tend to throw grave doubt on the *bona fides* of any apparent actual transference of thought. I must repeat, however, that I know nothing of the relations of Messrs. Blackburn and Smith to the Society, or to each other. If collusion between them be *impossible*, then undoubtedly a strong *primâ facie* case is made out for the possibility of the molecular motion of the grey matter of one brain exciting corresponding movements in that of another; but really, after my own personal experience while engaged in the investigation of that wicked imposture, "Spiritualism," I am tempted slightly to alter the conclusion of Bret Harte's immortal poem, and to say—

"Which is why I remark—
And my language is plain—
That for ways that are dark
And for tricks that are vain
The thought-reading medium is peculiar,
Which the same I am free to maintain."—ED.]

IS THOUGHT AN ENTITY?

[1736]—Mr. Edwin Wooton, in his able article on nervous exhaustion, introduces what seems to me an erroneous simile, viz., "that a soul is comparable to a musician playing on an organ." Haeckel, Büchner, and other eminent German scientists now quite discard the idea of a soul being an entity—independent, and something separate from brain activity. However, the simile, if applied, should be, "thought, mind, [or soul, are like the music, or sound proceeding from the piano or organ." For as music is the "effect" of the player acting on the instrument, so must thought, mind, or soul be the "effect" of stimuli acting on living, self-acting brain. If Mr. Wooton can call "music" or sound an entity, I am willing to grant that thought is an entity.

Again, the player does not reside within the piano or its material parts; the soul, however, of an entity must reside with a brain and its material parts. Further, a player can play a dozen "different" organs; a "soul" is confined to its single organ. Given a "self-acting" instrument, like a self-acting brain, what need for a player or soul? The one produces the "music," the other the thought; but neither would be called an entity. Thought seems like the scent of a flower, brought into existence by the warmth of life and sun, to depart when they are gone. Or, like a picture, a reflection, produced by an object reflected by the polished surface of a mirror—intangible, yet real—the effect of stimulus and response to stimulus. F. W. H.

BRAIN AND THOUGHT.

[1737]—Perhaps I may be allowed, in the interest of medical science as well as of common sense, to draw attention to the following anti-scientific statement in Mr. Edwin Wooton's otherwise instructive article on "Nervous Exhaustion," at page 435 of KNOWLEDGE, May 22:—"The brain is the organ of thought. It is an instrument used as a medium by a spiritual entity—the soul—which modern researches would lead us to believe is evolved from the nervous force with the development of the body *in utero*. Using a simile, the brain may be compared to a well-constructed organ, and the soul to the musician." Now there are no physiological or embryological experiments whatever to justify this occult dualism of soul (which, etymologically, = life) and body. It is an example of the same pre-scientific and anti-scientific fallacy as that of the Archæus, or "Vital Principles," as a separate entity apart from organisation—a provisional theory quite discredited by the progress of modern science, and which, in the court of reason, seems utterly inconceivable. For how can we coherently figure to ourselves the union and interaction of two such incompatible "entities" as a material substance and an immaterial "I know not what." The substantial and unsubstantial can in no degree cohere. Such a notion is as baseless in physiology as the corresponding chimera "ruling angel" in astronomy, or the principle of levity (phlogiston) in chemistry. The fact is, as lately stated in the *Nineteenth Century* by Sir W. Gull, that the inter-cranial ganglia function by virtue of their own *vis insita*, or native energy, just like extra-cranial nerve centres or other organs, and neither require or admit of any quasi "spiritual" factor, which can only be a nonentity superadded to the somatic organism. ROBERT LEWINS, M.D.

CONCEPTION AND SENSATION.

[1738]—"C. N." (1714) surely meant to write "Conception is of sensation, sensation is of the external"; and I will continue, the external therefore exists to me, for without it sensation and conception would be impossible. On what ground does "C. N." assume the non-correspondence of concepts with the things conceived? And supposing the assumption valid, would it destroy the co-relationship of mind and the external world? Were it verified ten thousand times, conception would still be dependant on the external for its concepts, and this means, if it means anything, that the external exists, and exists to me. I grant readily, as G. H. Lewes says ("Hist. of Phil.," 1857, p. 471), "Nothing exists" to us "but what is perceived." But I contend further that conceptions are results, the stimulating cause being the external. This must of necessity be so, otherwise mind is at once object and subject, which is absurd. J. S.

GENERIC IMAGES.

[1739]—The presentation of a number of images of the same kind in succession to a sensitised photographic plate, referred to in Miss Naden's paper, produces an analogous result to the rotation of the prismatic colours before the sentient eye. The photographic process is not yet perfected, but it may be. The revolving disc, with the colours, produces a closer approximation to a true *mean* impression than the photographic plate. At the Antwerp Art Congress in 1859 or 1860 I showed, in illustration of my theory of the beautiful, that *generic images* might be produced in the same manner as the neutralisation of the colours by rotation. I contributed a short paper on the subject of generic images to the British Association for the advancement of science, in consequence, if I recollect rightly, of Mr. Galton's paper pointing out the deeper significance of the teaching of his experiments. These *generic images*, in truth, confirm my theory of the evolution of art and of taste, as propounded in a paper of mine read at the Social Science Congress several years since—which was reported at the time—and which was designed to demonstrate that evolution, in the sense of a progression towards improved conditions, is always towards *mean* or proportioned conditions; and, therefore, in taste and in art, to proportioned taste, and proportioned art. I have known, in fact, that the same doctrine that Aristotle applied to ethics is also applicable to æsthetics, and to evolution in general.

W. CAVE THOMAS.

GEORGE ELIOT SETTLING IT!

[1740]—George Eliot—name and individual alike antipathetic to me; the woman who anonymously preached per "Dinah," while she utterly disbelieved Dinah's rhetoric; the woman who was not afraid of *being* what "the divine" Desdemona was afraid of *saying*; and yet was furious if any one addressed her as "Miss Evans"—George Eliot has pronounced upon the question of questions in the negative which Plato and Jesus answered in the affirmative, with an amount of "cocksureness" (you say the word is Shakespearian

—prithee, where?) which would be difficult to surpass; which makes us think of—

"Fools rush in where angels fear to tread."

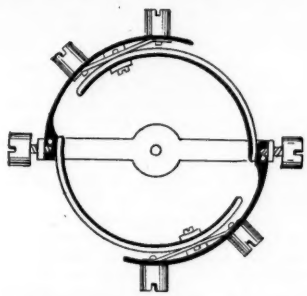
"Life is merely mechanism, after all. Undoubtedly!" quoth she! "Mystery is merely our ignorance," quoth she! Will she then explain—*e.g.*, the Mystery of Matter? Matter *always was* and *always will be*. Is *that* mystery only our ignorance? How would she explain the fact of apparitions after death? She has no more right to call (with her precious prig of a partner) thought a "secretion" than she has to call the telegraphic message a secretion. Is it not conceivable that this fabric of nervous tissue we are, may fade and perish; but the message, the I, remain? Then, as for her hauptmotis, old age, Goethe, for one, drew the exactly opposite conclusion. He, like Gladstone, Bismarck, Haydn, Wagner, Herschel, and a host of others, did *not* become a pitiable mockery in old age, but was so intellectually young and vigorous that he argued, "I have scarcely yet begun to draw upon my resources:—Nature is bound to give me the opportunity to go on."

If we are mere masks that crumble away, the Power whose manifestations we are is eternal; but that is not sufficient philosophy for man. His sense of personality (intense consciousness) leads him to the corollary and conclusion that *he* is immortal—a conclusion which is the finest fruit of evolution. The dismal disbelief is a case of "retrogressive development," indeed!

COMMENTATOR.

A NEW CHRONOMETER BALANCE.

[1741]—Enclosed I send diagram of chronometer balance, designed to correct the middle error temperature. The pin of the clamp connecting the two rims is supposed to occupy the centre of the straight bar screwed on the inside of the outer steel rim at the middle temperature of 60 or 65 degrees. Should a straight bar be found not accurately to eliminate the error, a slight curve either way, according to the error, must be given it. I have tried several different forms, but this is the best I have discovered.



Messrs. Dent and Crisp are the only two chronometer makers who have seen a drawing of this form, but I should like some of the others to pass their judgment upon it. THOMAS AYERS.

P.S.—One side of the clamp is omitted in drawing to show the connecting-pin.

DE GUSTIBUS.

[1742]—I have been nourishing an intention, with your permission, of laying before your readers at some future time a theory of the origin and rationale of the preferences in matters of taste, which were the subject of my letter, No. 1684, in KNOWLEDGE, No. 182, p. 355. As, however, to do so at present might seem like building on a foundation which has been exploded with dynamite by the letters 1708-9 in KNOWLEDGE, No. 185, pp. 421-2, I now ask for a little space for repairing the cracks.

With reference to picture-frames, which I said should preferably be unlike Fig. 3, p. 355, let any frequenter of picture-galleries reflect that, in the course of a few London seasons, not merely ten or a dozen gilt frames have been passed before his eyes, but hundreds, and perhaps thousands; and that only a small percentage of these have ever varied from symmetry in form.

Further, that on analysing that small percentage, the variation, as a rule, has been in conformity with one of my observations at p. 356. "Variation displays itself in things at different levels, between an elbow and a knee, &c." Thus, for instance, there will be found in the National Gallery, the "Vision of St. Jerome," by Parmegiano, of the shape of enclosed Fig. 9. (I continue the numbers from the former letter.) But not once in ten years will occur a picture shaped as Fig. 10, with two sides unsymmetrical at one level.

Again, one may consult a looking-glass of the common form of Fig. 11, and consider whether it is equally proper to fix it with the symmetrical corners at one level and at different levels. See Figs. 11 and 12.

Fig. 9.

Fig. 10.

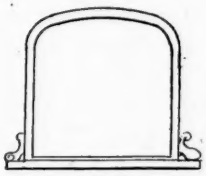


Fig. 11.

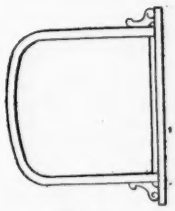


Fig. 12.

"I. B. C." objects to Fig. 4, for constructional reasons. I have some experience in construction, and would submit the section, Fig. 13, as showing a perfectly safe and practicable way of building an unsymmetrical church. It would be free from that vice so often seen in the vaulted aisles of cathedrals, where their thrust tends to compress the walls of the nave. Thus Westminster Abbey became disfigured with iron tie-rods, evidently to fence off the evil of such side thrusts. But the vicious vaulted aisles are beautiful, and the safe lop-sided nave would be ugly until made respectable by custom.

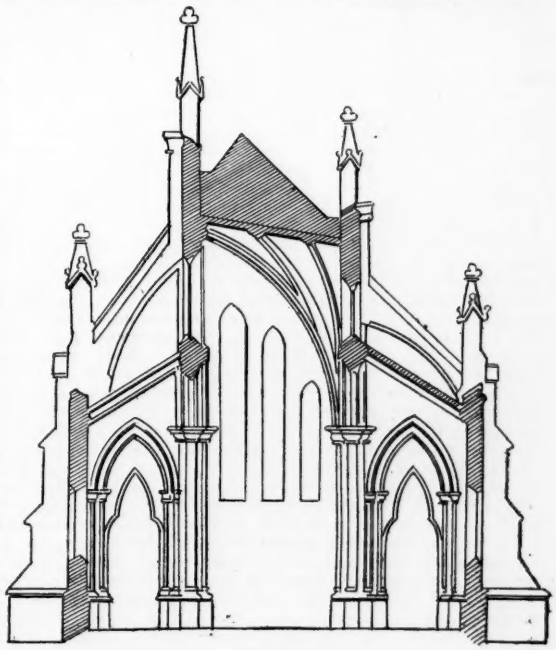


Fig. 13.

With respect to the "Bird," Fig. 5, p. 356, I submit that the ob-

jection to my position would have been far stronger than it is if "I. B. C." had been able to produce any monster having a head at the end of its tail, yet belonging to a recognised class, as do Sirens and Centaurs, and duly vouched for by Virgil or Ovid, as representatives of large constituencies of readers.

A chief source of the difficulty in investigating questions of taste seems to lie in the confusion of these separate elements in the question: I. Sensual physical excitement; II. Immediate intellectual satisfaction; III. Associations with past satisfactions of all sorts, also with present social feelings. To examine to the bottom one of these elements, one should temporarily ignore the others. In my explanation of Hogarth's "Line of Beauty" (KNOWLEDGE No. 180, p. 313), I treated the matter as an intellectual one, excepting so far as introducing incidentally physical fatigue to the eye. Intellectual and physical pleasure and labour may attend an astronomer's proceedings as he watches a transit of Venus. What a conglomeration of affections will ensue if, just at the most critical moment, a messenger rushes in to tell him that at his distant home a child has been born to him; and, moreover, that a remote relative, dying, has bequeathed him a million of money. Fine art deals with such conglomerations of intellect, affection, and the varied interests that stir mankind.

AN OLD DRAUGHTSMAN.

LETTERS RECEIVED AND SHORT ANSWERS.

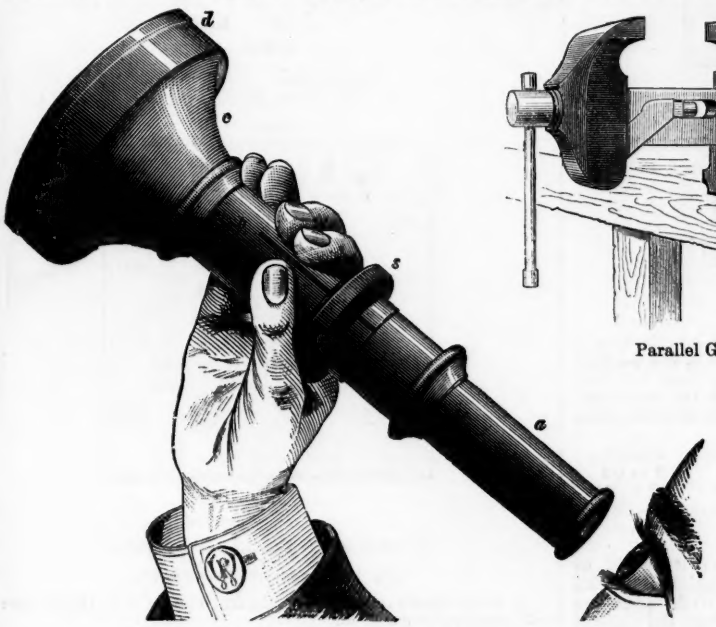
C. LENI. Correction made elsewhere. Thanks.—C. E. CLARK. It begins verse seven of the exordium to "In Memoriam," by Tennyson. See printed notice, in capital letters, which concludes those heading the correspondence column.—H. R. B.—"Action at a distance" is rather (in the present state of our knowledge) inconceivable than unbelievable. Clerk-Maxwell, following Faraday, was disposed to refer all such seeming action, as in the cases of magnetism, gravity, &c., to the vibrations of an intervening medium; but my own difficulty has always been this, that any kind of undulation or vibration whatever must take *time* to be propagated, whereas—certainly in the solar system—the action of gravity is absolutely instantaneous. I am quite with you in your expressed belief that "Gravitation is the profoundest of mysteries," and think that a considerable advance must be made in our existing acquaintance with cosmical physics ere it can be removed from that category.—W. "Holmdale" wanted to draw a meridian line in a house, before the roof was covered in. You may give me credit for the possession of a sufficient knowledge of rudimentary astronomy to justify me in asking you to believe that I could have given that querist more than one way of rigidly determining the meridian had he only possessed the proper instruments. You greatly exaggerate the difficulties in the way of obtaining a very fair approximation indeed to it by the method of equal altitudes, which is of very great antiquity. If "Holmdale" did get the meridian within 1°, it would be amply accurate for his purpose; and I gravely doubt if he would obtain it any nearer by the method you gave. Of course, *if* a man has a rigidly accurate chronometer, *if* he knows his longitude thoroughly well, and *if* Greenwich time is accurately flashed (which it but too rarely is) to a Post-office close to him, then the shadow of a long plumb-line at apparent noon will give him a better meridian still. You will be quite prepared to hear that I am sitting limp and helpless at the editorial desk after your withering sarcasm!—JOHN HAMPDEN. Well, I suppose that one reason why the *Challenger* did not discover the South Pole was that she was despatched for a totally different purpose, and without the very slightest intention of proceeding thither. Moreover, the former experience of Captain Ross and others, and the familiar fact that ice in the Antarctic Ocean extends 10° nearer to the Equator than it does in the northern hemisphere, forbids the hope that the actual Southern Pole itself will be reached. The reason for the delay in the appearance of the *Challenger* reports in their entirety is, that each separate section of them has been committed to men whose ample knowledge of the subjects respectively treated of by them ensured their being worth reading. It is surprising how much more valuable a man's opinion becomes, and how much more readily he is listened to, when he possesses some acquaintance with the subject on which he dogmatises. Would you consider me very rude if I offered this hint for your personal consideration?—J. O. CALLAGHAN points out, in connection with a paragraph in the "Editorial Gossip," on p. 440, that the "Hamburg Lotteries" there denounced are advertised in English provincial papers. How far the proprietors of these papers render themselves "accessories," perhaps some common informer will endeavour to discover. The gravest charge, though, is against our paternal Government, which actually gives through its Postal Department every facility for, and enticement to, the commission of a highly penal offence.—FACIEBAT says (in connection with a reply to Mr. Jarman, on p. 446) that Green mentions fan (like) structure in his "Physical Geology," and that Jukes (somewhere or other) talks of "fan-shaped," though without mentioning structure. No. I have written "cœlo" for more years than I care to count, and shall not now alter it to "cælo," any more than I intend to use "Kikero" for "Cicero." I regret that I do not know the address. Mr. Caldicott's letter, with a pile of others, was torn up straightway when dealt with.—JAS. GRESHAM. Handed to the writer of the article.—M. T. H. Nothing hinges on the method of describing specular reflection. "In a looking-glass" is merely *façon de parler;* everybody is agreed as to the nature of the phenomenon. *The* question is, is anything reflected if there be no percipient eye in the line of the reflected ray: all else is surplusage. —JOHN ABBOTT. What, in the name of fortune, do you send *me* four and fourpence for?! You should have written to Messrs. W. Bundy & Co., whose address will be found appended to their advertisement, and whither your letter will have now to be sent from the office.—DR. LEWINS. Your reply to Mr. Wooton will appear, but your other letter merely reiterates, with slight and unimportant variations, arguments which have been before advanced in these columns. Thanks for the "Mason's College Magazine."—B. T. LOWNE. Yes; I am familiar with the discussion, and shall be very glad to insert your exposition *in extenso*. In the present crowded state of our columns, however, I can only accept it as a voluntary contribution. —WILLIAM BOGGETT. It is always advisable to be sure of your facts before framing hypotheses. Electricity is not, as might be assumed from your pamphlet, a substance, but a mode of motion. Ice continues to conduct electricity, though imperfectly, until it is cooled down to −13° Fah., when it really becomes a non-conductor. Read some modern work on the subject, like Professor Thompson's, published by Macmillans.—JNO. R. WEBB. "Faciebat," as you will see above, refers to Green's book, as one in which the wards "fan-shaped structure" are to be found. As for Geikie's text-book, I had it at my elbow, so that I should have, perhaps, modified my original statement had I opened it. All the same, the practice does exist in the South Kensington examinations of giving questions answerable only from the cram-books compiled by people belonging to or dependent on the "Department."—F. W. RUDLER. Received with thanks.—HALLYARDS. Your reply to Miss Ballin shall appear in due course; as shall your article on certain corruptions of English. The other two I return to you. To insert your table-turning letter would be to open the door to a flood of "Spiritualistic" correspondence, which I am thoroughly determined shall never discredit these pages. I have myself seen a table tilt and go round, have watched the absolutely unconscious muscular action by which it was caused to do so, and have stopped it at will by simple pressure in the opposite direction. The difficulty of trusting to the evidence of one's own senses in these matters is enormous. *Est natura hominum novitatis avida,* and our appetite for the marvellous grows with what it feeds upon. When I was engaged some years ago in a thorough investigation of (so-called) "Spiritualism," I have seen things almost with awe, which, on subsequently learning the secret of their performance, I have cursed my own folly for not detecting at once. If once the thin end of the wedge enters here I must be impartial, and we shall have tables moving without contact, followed by slate-writing, spirit hands, "materialisation," and the rest of the contemptible impostures by which "Media" prey upon the fatuous idiots who support them. Your second letter I cannot insert, for reasons hinted at in my former reply. Its subject is scientific, but, 1st Corinthians vi., 12 v., KNOWLEDGE has a very varied *clientèle* indeed, and is addressed *pueris virginibusque* among others. I am not concerned to deny that the article on which, as you say, it is a corollary, is not, in one sense, improving reading; but I daresay it will astonish you not a little to know that that article was one of a series written for a specific purpose, which even I do not see until they are up in type. With regard to your strictures on Mr. Browning's papers, you can scarcely be aware that some subscribers take this journal for the sake of the tricycling articles in it, and grumble because there aren't more of it! The Fontenelle ones were started by the Conductor, as a contribution towards the history of the growth of astronomical knowledge; and, once begun, can scarcely be cut suddenly short because they, unhappily, fail to meet with your personal approval. Knowing something of editorial "drive," you will, I know, forgive me for not entering into further details here. — ORIENTAL ASSOCIATION. Received.—T. S. USBORNE. I am as sworn a foe to both as you can possibly be; but that paragraph gave no countenance to either.—E. J. M. What you really mean is that you wholly failed to find out how the trick was done.—A. C. HARRIS. The School of Submarine Telegraphy and Electrical Engineering, to which you refer, has been in existence for several years, and two articles have appeared in KNOWLEDGE concerning it. Its address is 12, Princes-street, Hanover-square, London, W.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

MICROSCOPES.

MESSRS. M. THEILER & SONS, of 86, Canonbury-road, London, N., are just now introducing two microscopes new to the English market. One of them is called the "Demonstration" microscope, and is expressly designed for use in schools and in the drawing-room. It has three powers, magnifying 30, 100, and 150 diameters respectively. The construction is very simple, and the workmanship of the best. The ocular tube or eye-piece slides into another tube, *a*, which carries the object-glasses, and which in its turn slides into the split tube, *b*, being held in position by the clamping-ring, *s*, which screws on to a slightly-tapered thread on *b*. It will be observed that the instrument is used by holding it against the light, which passes through a small hole in the lid or diaphragm, *d*. A highly-polished concave mirror (with a central hole for the passage of light and of the object-glass) is fitted in *c*, being pressed forward by means of a spring. Two segmental strips of metal are fastened to the rim of *c*, and the slides are held between these strips and the mirror by the aid of the spring already mentioned.



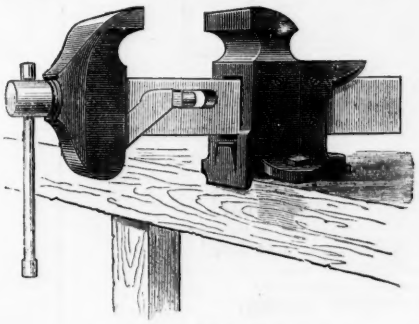
The "Demonstration" Microscope.

The instrument being duly focussed, it may be handed round to any number of persons, each spectator adjusting for his own eye-sight, if necessary, by the ocular tube, no other alteration being necessary. It must be seen that the convenience of manipulation is all that could be desired, while no praise we could bestow upon the instrument, either as a piece of mechanism or as a microscope, would be too great—that is to say, within its own sphere. It is cheap, and certainly superior to many other instruments of a considerably higher price.

The other instrument of Messrs. Theiler is called the Universal "Pocket" microscope, which magnifies fifty diameters. It is enclosed in a case measuring about 2½ in. square and about ¾ in. deep. In the case are also a good botanical lens (magnifying six diameters), three specimen slides, two empty slides (for securing preparations to be examined), and a third slide provided with a cavity (for holding a drop of water or any other liquid). This instrument is a virtual microscope, giving beautifully-defined images, and, like the Demonstration Microscope, may be used either by the aid of day or lamplight. No one having any interest in microscopy should leave home unaccompanied by such a small and so efficient an instrument. Its cost may be measured in the inverse ratio to its utility and value.

PARALLEL GRIP VICE.

This tool, introduced by the Coventry Machinists' Company, is a simple form of the latest innovation in the way of vices. A series of transverse notches or screw threads is cut on the under side of the slide (which is of square or rectangular section). Corresponding threads are cut in a piece of steel or iron at the bottom of the slot in the back jaw. The front jaw can, and is only required to be, moved a very short distance along the slide, this movement being effected by turning the lever handle one way or the other. To fasten an article in the vice, all that is necessary is to hold it between the jaws with one hand, and raising the loose or front jaw (and the slide with it) with the other hand, push it into contact with the article. The threads on the slide dropping into the threads in the slot of the back jaw, all that is necessary is to secure the article rigidly. This is done by giving a half-turn to the handle in front, when the hole will be screwed together tightly, the jaws being at all distances parallel. To release the article the handle is unscrewed half a turn, the front jaw slightly raised, and the slide withdrawn to any desired distance. The vices are well made and simple in construction, while there is little or nothing to get out of order.



Parallel Grip Vice.

CARRIAGE READING-LAMP.

[Patent 6,925. 1884.]—This lamp has been patented by Mr. Hartshorne, of 39, Newhall-street, Birmingham. It is held in position by means of a vice, which is made to grip the front of a railway-carriage cushion, easy-chair, sofa, ship's cabin, seat, or any other suitable support. An arrangement of telescopic tubes carries the tube which contains the candle. The candle is raised during combustion by a spiral spring. When in use, the height of the light can be adjusted by the telescopic tubes, and, for convenience of packing, the whole apparatus can be closed into a small box three inches wide, one and a-half deep. A semi-circular reflector, which easily turns with the candle-tube, enables the reader to concentrate the light on any desired part. The lamp is well and strongly made, is very durable, and should commend itself to travellers.

Carriage Reading-Lamp.

Our Chess Column.

By MEPHISTO.

ENDING FROM ACTUAL PLAY.

TERMINATION of a game at the odds of Pawn and move, played in the Handicap Tournament of the City Club :—

J. GUNSBERG.

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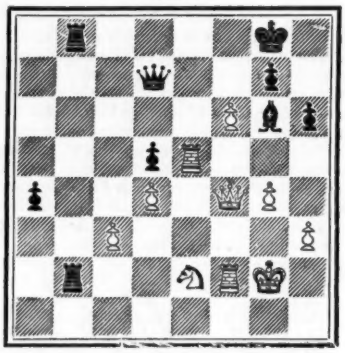

WHITE.

F. ANGER.

Black played

	R to KB sq.
R to K7	Q × R !
P × Q	R × Q
Kt × R	R × R (ch)
K × R	P to R6 !
Kt × B	K to B2
Kt to K5 (ch)	K to K sq. !

and Black must Queen his Pawn and win.

THE CENTRE GAMBIT.

IN our criticisms of the move of 4. B to Q3 for Black, as a defence in the Centre Gambit, *vide* KNOWLEDGE, p. 425, we have been led into an error in following up one of the variations. For, as the *Leeds Mercury* points out :—If now

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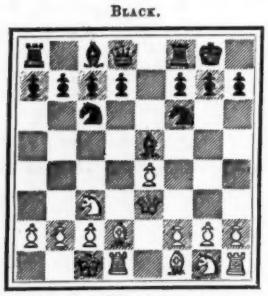

WHITE.

8. P to B4	B to Q5
9. Q to Kt3	P to Q3
10. Kt to B3	Kt to R4
11. Q to K sq.	B × Kt
12. B × B	Kt × P
13. Q to Kt3	

Now 13. Kt to R4 would be sufficient to maintain Black's superiority. While admitting this, we do not see the slightest reason that this should alter our general judgment of the position. For supposing after 8. P to B4, B to Q5 the White Q retires to K sq., as recommended by us, then 9. Q to K sq., P to Q3. 10. Kt to B3 to be followed by B to Q3, after which the advance of the Pawns on the K side would become dangerous. White has nothing to fear from B to KKt5, as P to KR3 would dispose of the B. White has a good development, and it would be bad judgment to play P to B5 early, so as to provide Black with a convenient square for his B or Kt on K4. But P to B5 may come in very useful later on, when both the B and Kt are displaced, which, for example, could be affected after 10. Kt to B3, by White being able to continue with B to QKt5, in which case the Black B must retire from Q5, and White can play B × Kt, followed by P to B5. Besides, instead of 8. P to B4, White may play a variety of moves, such as 8. Kt to B3, or 8. KKt to Q2, or 8. Kt. to Q5, or 8. B to Kt5, &c., from which will be seen that the question is so much one of general judgment, that we must leave it there. In reply to a special request, we have duly given our opinion of the move of 4. B to Q3, without any idea of entering into any analytical controversy. We should never think of criticising any opinions held by another paper, except it be on a subject of general comment. The proceedings of the *Leeds Mercury* are, therefore, somewhat irregular.

ORIGINALITY OR ECCENTRICITY.

WHEN two strong players meet in order to play "skittles," there usually may be seen some sparks of brilliancy flying about. The other day, seeing two such players settle the preliminaries of a challenge without a referee, we determined to watch the play, and look out for the sparks. The result fully justified our expectations. We therefore give a faithful narrative of the encounter. A, having White, hesitates a little. "Are you trying to invent a new move?" asked B, "if so, please do it at home!" "Well," said A, "I dislike regular openings; I think I shall try something that will floor you." Many more conversations of the kind occur in our shorthand notes, but we shall content ourselves by giving the game pure and simple, and leave our readers to judge whether A succeeded in being original.

VERY IRREGULAR OPENING.

White. A.	Black. B.	White. A.	Black. B.
1. P to KB4	P to K4	9. K to Q3	Kt to B3 !
2. P × P	P to Q3	10. Q to K2	P × Kt
3. P × P	B × P	11. P to B4	Q × RP!
4. Kt to KB3	P to KKt4 !	12. P to K5	B to B4 (ch)
5. P to K4	P to Kt5	13. K to B3	Kt to K5 (ch)
6. Kt to Q4	Q to R5 (ch)	14. K to Kt3	R to Kt sq. (ch)
7. K to K2	Kt to QB3	15. K to R4	B to QKt5 !
8. Kt × Kt	P to Kt6 !	16. P to Q4 Resigns	Q × R

PROBLEM No. 157.

By J. W. McKEAN.

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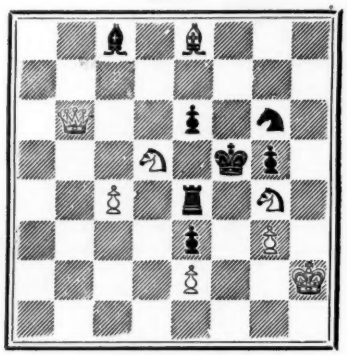

WHITE.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

R. P. F.—Game received with thanks; the point of the sacrifice will receive our attention.

CECIL, A. L. BULL.—Both Problems received with thanks.

J. J. CRIDLAW.—Solution correct.

J. J. McKEAN.—We have published several of your Problems, and will send you copies in a few days. Shall be glad to receive more. Excuse our unconquerable aversion to private correspondence.

B. G. LAWS.—Letter and Problem received with thanks.

A. J. W.—We shall look over game as occasion arises.

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